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INDEX NUMBER

DECEMBER 1951
VOLUME 54 NUMBER 6

Published Monthly by
AMERICAN MEDICAL ASSOCIATION
535 NORTH DEARBORN STREET • CHICAGO 10, ILLINOIS

Entered as Second Class Matter Jan. 14, 1925, at the Postoffice at Chicago, Under the Act of March 3, 1879. Annual Subscription, $12.00

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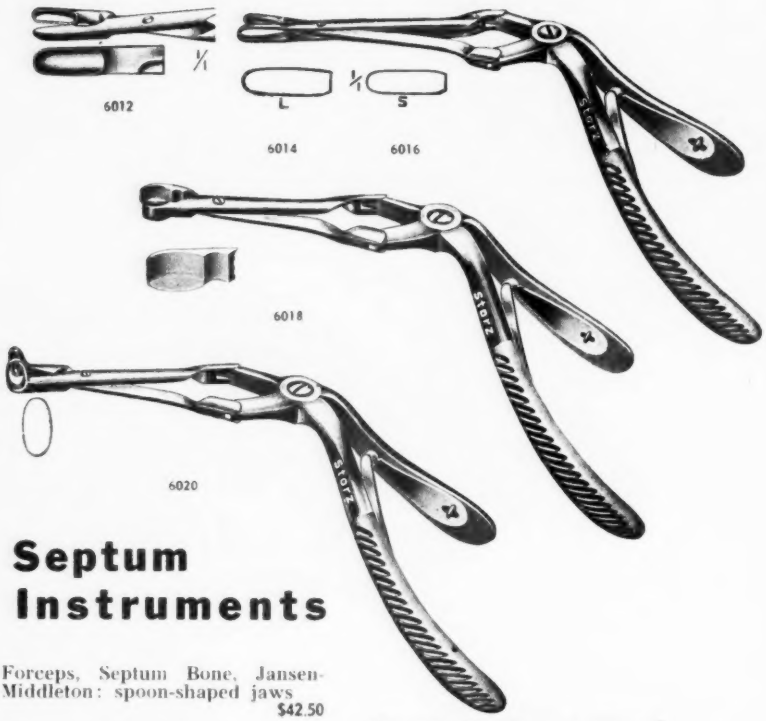

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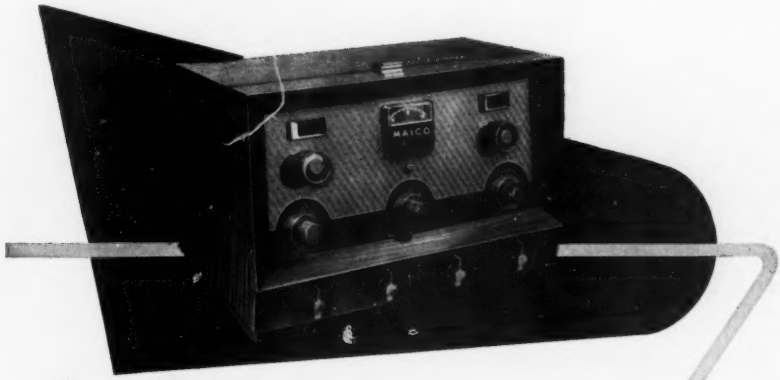

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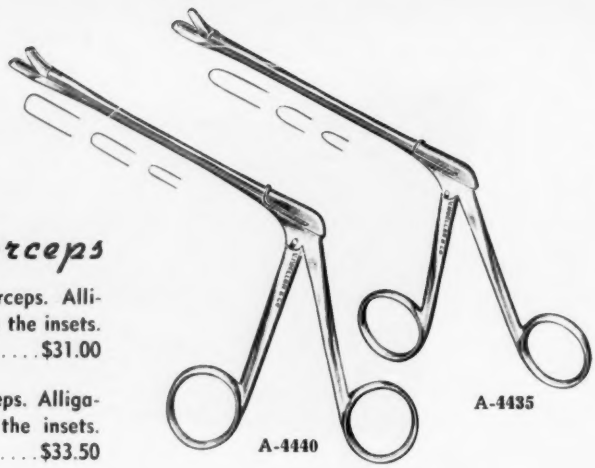

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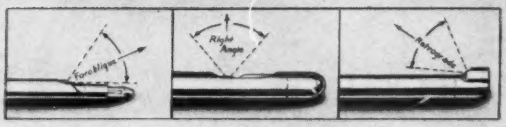

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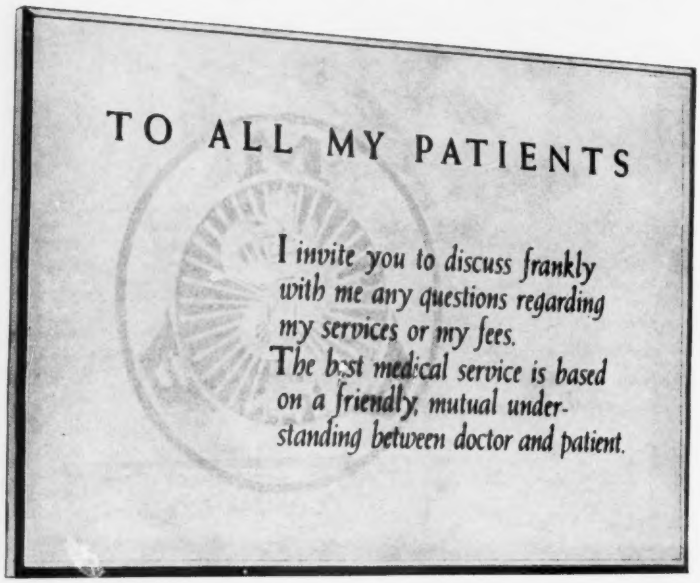
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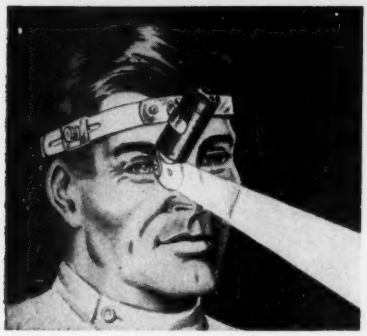

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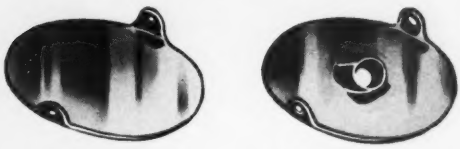

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ARCHIVES OF OTOLARYNGOLOGY

VOLUME 54 DECEMBER 1951 NUMBER 6

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NONHEMOLYTIC STREPTOCOCCI IN RELATION TO AN EPIDEMIC OF INFLUENZA

Diagnostic Cutaneous Tests and Specific Treatment

EDWARD C. ROSENOW, M.D.
CINCINNATI

THE EPIDEMIC reported herewith occurred in a large state hospital for the insane in January, February, and March, 1950. The onset of the epidemic was abrupt, occurring at almost the same time in different wards of the hospital. The attack rate was far greater in women than in men. Among the attendants 9 men and 23 women and among the patients 94 men and 269 women had symptoms of respiratory infections resembling moderately severe influenza. The onset of symptoms was usually sudden, consisting of prostration, general aching, moderately sore throat, usually slight coryza, pain in the chest due to bronchitis followed by cough, and expectoration of mucopurulent sputum. Sensations of chill at the onset often occurred, but a definite chill was usually absent. There was mild to moderate fever lasting for from several days to a week or longer. The symptoms at the onset were out of proportion to the physical signs. The throat, tonsils, uvula, and sometimes the soft palate were congested and edematous. Examination of the chest in the early stages showed nothing significant, while later evidence indicating areas of bronchiectasis, emphysema, and patchy consolidation was relatively common. The incidence of deaths from bronchopneumonia chiefly in the aged increased with the occurrence of cold weather as respiratory infections, including the epidemic, increased, and diminished with the return of warm weather. Thus two deaths from bronchopneumonia occurred in aged patients in October, 1949; 3 in November; 6 in December; 8 in January, 1950; 10 in February; 6 in March; 4 in April, and 2 in May.

Penicillin, sulfadiazine, or only general care and symptomatic treatment was used in the different wards by the respective attending physicians with apparently comparable results. The results of the use of penicillin during the primary outbreak were disappointing. Abrupt disappearance of fever with striking clinical improvement, which is the rule in pneumococcal pneumonia and other pneumococcal infections and infections due to hemolytic streptococci, almost never occurred. This lack of apparent effect occurred regardless of the duration of the disease and despite relatively high concentration of penicillin in the blood and urine of the patients after the intramuscular injection of 200,000 units of penicillin every six hours.

In order to determine the probable reason for the ineffectiveness of penicillin, cutaneous tests were made to determine specific streptococcic antigen and antibody

From the Bacteriological Research Department, Longview State Hospital.

in the skin or blood[1] of the patients and the bactericidal action of progressive dilutions of penicillin on the freshly isolated nonhemolytic Streptococcus, Diplococcus pneumoniae, hemolytic streptococci, and Staphylococcus aureus. One or more therapeutic injections of thermal antibody, with or without the corresponding vaccine, prepared from nonhemolytic streptococci isolated in previous studies of respiratory infections and in the current epidemic were given subcutaneously to persons who were receiving penicillin or sulfadiazine and to those not receiving these medicines or other medication.[2]

METHODS OF STUDY

Cultures were grown from material from nasopharyngeal swabbings, from blood, and from samples of the milk supply. Mice were inoculated to determine virulence of the organisms. Agglutination and cutaneous tests with streptococcic thermal antibody and antigen were made to determine antigenicity of the streptococci. The streptococci whose virulence and other properties were studied were isolated from the end-point of growth in serial dilution cultures in dextrose-brain broth, from material from nasopharyngeal swabbings of persons ill, and from samples of the milk supply. They were not isolated from aerobic mediums such as nutrient agar without or with the addition of blood.[3] Some mice were inoculated cerebrally with 0.03 ml. and nasally with 0.06 ml. of streptococci while under ether anesthesia, and others were inoculated intraperitoneally with 1 ml. of the various young dextrose-brain broth cultures. Mice that died were examined as soon after death as possible, and those that survived the inoculations were anesthetized with ether and examined three to five days after inoculation. Antigenic specificity for agglutination tests and for preparation of antibody and vaccines and, for a time, viability of the streptococci were preserved by partial dehydration of the streptococci in very dense suspensions (300,000,000,000 to 1,000,000,000,000 streptococci per milliliter) of glycerin, 2 parts, and saturated sodium chloride solution, 1 part, kept at 10 C.

The agglutination titers of the blood serum of persons ill and recovered were determined at four fivefold dilutions of 1 to 5 to 1 to 625 and those of thermal antibody at four fivefold dilutions of 1 to 20 to 1 to 2,500 for the streptoccci isolated from material from the nasopharynxes of persons ill and from the milk. In order to permit easy comparisons, the degrees of agglutination are given in per cent of the total possible; thus a 4+ agglutination for each of the four dilutions, or 16/16, is 100%; a 9+ agglutination of 9/16 is 56%, etc. The mixture of serums and antibody and the bacteria were incubated at 48 C. for 18 to 24 hours, after which time readings were made.

Thermal antibody used in skin tests for antigen consisted of the bacteria-free supernatant of sodium chloride solution suspensions containing 20,000,000,000 streptococci per milliliter or cubic centimeter that had been autoclaved at 17 lb. pressure for 96 hours and then diluted with an equal volume of isotonic sodium chloride solution containing 0.4% phenol.[1] The antigen for the detection of antibody in skin or blood on intradermal injection consisted of the supernatant sodium chloride solution suspensions containing 10 billion streptococci per milliliter heated at 70 C. for one hour. Thermal antibody for treatment was prepared by autoclaving for three hours sodium chloride solution suspensions containing 10 billion streptococci per milliliter after adding 1.5% hydrogen peroxide and bringing the pH to 6.5.[2]

The bactericidal or bacteriostatic action of the blood and urine of persons treated with penicillin and of progressive tenfold dilutions of penicillin and other antibiotic agents were studied by a new method. The method consisted of superimposing the test solutions onto 0.75% nutrient agar in small tubes ⅜ in. by 3 in. (1 by 7.6 cm.) previously seeded with the various organisms and allowed to congeal. The tubes were then placed in the incubator immediately or

1. Rosenow, E. C.: Production in Vitro of Substances Resembling Antibodies from Bacteria, J. Infect. Dis. **76**:163-178, 1945.

2. Rosenow, E. C.: Studies on the Nature of Antibodies Produced in Vitro from Bacteria with Hydrogen Peroxide and Heat, J. Immunol. **55**:219, 1947.

3. Rosenow, E. C.: Isolation of Bacteria from Virus and Phage by a Serial Dilution Method, Arch. Path. **26**:70-76 (July) 1938.

TABLE 1.—*Cutaneous Reactions in Persons Having Simple Schizophrenia Who Contracted Influenza in Wards of the Hospital in Winter, 1950.**

Persons Tested		Condition of Persons Tested	Duration of Disease, Days	Patients Tested, No.	Cutaneous Reactions (Sq. Cm.) to Thermal Antibody and of Antigen Prepared from Streptococci Isolated in Studies of: Influenza or Other Respiratory Infections, Antigen	Influenza or Other Respiratory Infections, Antibody	Virus Pneumonia, Antigen	Virus Pneumonia, Antibody	Schizophrenia, Antigen	Well Persons, Antigen	D. Pneumoniae I, II, III, Antigen
Ward 14	Men	Having influenza	1-3	13	**14.43**	3.05	**7.90**	....	*11.09*	0.88	1.16
			4-14	15	**10.50**	**8.17**	**9.27**	....	*7.12*	2.35	0.89
		Convalescing from influenza	21	8	3.56	**9.28**	1.21	....	*6.39*	....	0.78
		Ward contacts not having influenza	...	19	7.90	**7.03**	7.20	3.24	*7.07*	2.10	....
6 Wards	Women	Influenza	1-4	16	**7.67**	5.18	**8.77**	3.01	*6.31*	....	4.17
4 Wards		"Virus" pneumonia	1-5	19	**9.67**	5.68	**10.73**	6.90	.....	1.86	4.84
Ward 43		Influenza	1-4	16	**10.57**	5.16	**7.65**	2.62	*6.56*	....	3.34
		Convalescing from influenza	15-21		6.09	**8.22**	3.84	**6.82**	.....	....	2.82
Ward 4A		Men having influenza 25 days later	1-5	19	2.67	2.12	1.34	2.66	.....	1.23	1.52
Men at dairy farm		Having influenza	4-21	10	**10.93**	**13.51**	5.49	6.28	0.84	2.16	....
		Not having influenza	...	10	6.60	*11.57*	5.49	7.45	1.80	1.34	....
Persons having respiratory infection not in hospital			1-8	30	15.32	7.91	....	....	2.35	0.94	....

* The bold-face and the italicized numbers indicate reactions specific for respiratory infections and schizophrenia respectively.

in the refrigerator at 10 C. for one or more days, as indicated by the type of material under study, and incubated at 35 C. for 18 or 24 hours. The column of inhibition, if any, was then measured and recorded in millimeters in terms of the duration of refrigeration at 10 C. and incubation at 35 C.

RESULTS OF CUTANEOUS TESTS

The results of cutaneous tests made with thermal antibody and with antigen are summarized in Table 1. It will be noted that the reactions to thermal antibody prepared from streptococci isolated in studies of respiratory infections and virus pneumonia indicating antigen in skin or blood and hence a corresponding streptococcic infection were maximal at the onset of the disease in all patients tested in the different wards except those in Ward 4A, where a sudden outbreak occurred 25 days after the primary epidemic and where cutaneous reactions were far less pronounced. The reactions to antibody indicating antigen diminished with time

TABLE 2.—*The Effect of Therapeutic Injection of Thermal Streptococcic Antibody on the Cutaneous Reactions to Thermal Antibody and Antigen Indicating Antigen and Antibody Respectively in Relation to Penicillin Treatment**

Persons Having Influenza that	Persons Tested, No.	Duration of Disease in Days; Time of Treatment with Streptococcic Thermal Antibody and Vaccine	Average Cutaneous Reactions (Sq. Cm.) to Intradermal Injection of Antibody and Antigen Prepared from Streptococci Isolated in Studies of Epidemic Respiratory Infection Indicating, Respectively, Streptococcic			
			Antigen		Antibody	
			Before Therapeutic Subcutaneous Injection of Streptococcic Thermal Antibody and Vaccine	24 Hr. After	Before	24 Hr. After
Had not received penicillin.....	5	1-4	18.57	**6.78**	5.84	**16.05**
	5	5-7	18.27	**6.52**	8.13	**16.69**
	5	8-21	14.29	**10.09**	5.97	**13.93**
	9	2-7	14.99	**5.87**	6.10	**14.03**
Had received 200,000 units penicillin every 6 hr.....	9	3-10	13.61	12.48	5.49	5.98

* The bold-face numbers indicate specificity.

as recovery ensued. This occurred alike in men and women patients. Reactions to antigen indicating antibody were least pronounced early in the course of the disease and increased as symptoms subsided. Interestingly, persons in Ward 14 who remained well reacted moderately to antibody and to antigen, and the antibody titer was greater than that in persons at the onset of the disease. In keeping with the fact that these patients were simple schizophrenics, reactions to antibody prepared from the Streptococcus isolated in studies of schizophrenia, while less pronounced than reactions to "respiratory" antibody, diminished only slightly as recovery from influenza occurred. Reactions to "schizophrenic" antibody were negligible among the three nonschizophrenic groups tested as controls. Reactions to antibody prepared from streptococci isolated from well persons and from D. pneumoniae were also negligible.

The effect of subcutaneous therapeutic injection of 1 or 2 ml. of thermal antibody [2] on the cutaneous reactions after 24 hours in patients in different stages of influenza who had not or had received penicillin is summarized in Table 2. A striking diminution of reactions indicating antigen and an even more striking increase in reactions indicating antibody occurred consistently in all persons ill who had not received penicillin. Similar injections of thermal antibody in nine

patients with influenza who were receiving 200,000 units of penicillin each at intervals of six hours had no such effects. In most instances, a concomitant or seemingly consequent clinical improvement occurred in the patients not receiving penicillin, and no improvement occurred in those who were receiving penicillin.

BACTERICIDAL ACTION OF BLOOD SERUM AND URINE AFTER INTRAMUSCULAR INJECTIONS OF PENICILLIN

The bactericidal action of the blood serum and urine of persons ill with influenza was tested against nonhemolytic streptococci isolated in the current epidemic and against D. pneumoniae and beta hemolytic streptococci after the therapeutic intramuscular injection of penicillin. A great difference in sensitivity of the test organisms was found. Thus the average bactericidal action of 21 samples of blood serum obtained three to six hours after penicillin injection averaged 10 mm. for

TABLE 3.—*Sensitivity to Penicillin of Nonhemolytic Streptococci As Isolated from the Nasopharynx of Persons Having Influenza in Relation to Response and Nonresponse to Penicillin Treatment and to the Cutaneous Reactions Following Intradermal Injection of "Influenzal" Streptococcic Thermal Antibody.*

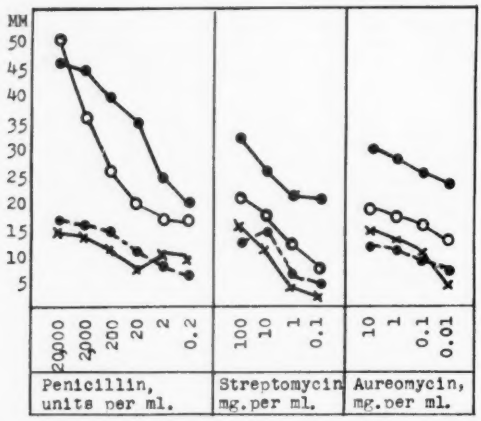
Type and Source of Nonhemolytic Streptococci and, as Controls, D. Pneumoniae, Hemolytic Streptococci, and Staphylococci			Reactions to Intradermal Injection of Influenzal Streptococcic Thermal Antibody (Sq. Cm.)	Bactericidal Action (Mm.) of Progressive 10-Fold Dilutions of Penicillin when Superimposed on 0.75% Nutrient Agar in Tubes Seeded with the Nonhemolytic Streptococci							
				Units of Penicillin Per Tube							
				20,000	2,000	200	20	2	0.2	0.02	Control
Nonhemolytic; isolated from nasopharynx of persons having respiratory infections resembling influenza that	Did not	Respond to penicillin treatment	15.90	27	24	20	12	5	0	0	0
			12.57	30	20	22	12	4	0	0	0
			19.64	27	24	19	12	7	0	0	0
	Did		15.90	17	14	11	6	0	0	0	0
			7.07	30	27	24	20	15	9	5	0
			9.62	24	20	17	15	10	6	2	0
			1.77	25	23	22	17	14	9	2	0
			7.07	28	27	25	23	19	10	4	0
D. pneumoniae types I, II, III			Laboratory cultures	24	21	18	13	12	5	3	0
Beta hemolytic Streptococcus				33	32	26	23	19	14	10	0
Staphylococcus aureus				19	16	12	11	0	0	0	0

nonhemolytic streptococci isolated in this study, 14 mm. for D. pneumoniae, and 17 mm. for beta hemolytic streptococci. The difference in sensitivity to penicillin in tests of the bactericidal action of the urine against these organisms was even greater. Thus the average bactericidal action of 43 samples of urine from 37 patients obtained 30 minutes to 8 hours after 200,000 units of penicillin was injected intramuscularly was only 13 mm. for the nonhemolytic streptococci, 28 mm. for D. pneumoniae, and 26 mm. for hemolytic streptococci. The blood serum from 40 persons and samples of urine from 52 persons not receiving penicillin and, as a control, the blood serum and urine from persons receiving penicillin 24 to 48 hours after injection had no bactericidal action. Interestingly, blood serum and urine obtained from patients with "influenza" in Ward 4A (Table 1) who responded to penicillin treatment and whose cutaneous reactions to influenzal streptococcic thermal antibody were slight were as bactericidal to the nonhemolytic Streptococcus isolated from material from their nasopharynxes as to D. pneumoniae and to hemolytic streptococci.

In Table 3 are summarized the results of a study of cutaneous reactions to thermal antibody in relation to penicillin treatment and in relation to the sensitivity of the isolated nonhemolytic streptococci, D. pneumoniae, beta hemolytic

streptococci and Staphylococcus aureus to penicillin in vitro. The persons ill who reacted strongly to the cutaneous injection of thermal antibody prepared from the Streptococcus isolated in influenza and other epidemic respiratory infections usually did not respond to penicillin treatment and the streptococci were found to be highly resistant to dilutions of penicillin in vitro. In contrast, the persons ill who reacted far less to the cutaneous tests responded to penicillin treatment, and the streptococci were highly sensitive to penicillin in vitro, resembling in this respect the sensitivity to penicillin of D. pneumoniae and hemolytic streptococci.

Penicillin and other antibiotics are far less effective in the treatment of epidemic respiratory infection including influenza due to or associated with nonhemolytic streptococci than in those associated with D. pneumoniae and hemolytic streptococci. I have studied by the method described the bactericidal or bacteriostatic action of penicillin, streptomycin, and aureomycin in vitro against pooled cultures



Bactericidal action of penicillin, streptomycin, and aureomycin on D. pneumoniae, beta hemolytic and nonhemolytic streptococci, and Staphylococcus aureus. Bactericidal action is measured in millimeters in seeded tubes of agar. D. pneumoniae types I, II, and III are indicated by the black dots joined by solid lines, hemolytic streptococci by white dots joined by solid lines, nonhemolytic streptococci by black dots joined by broken lines, and Staphylococcus aureus by crosses joined by solid lines. Dilutions and bactericidal agents are given below the graphs.

of nonhemolytic streptococci isolated in this and other studies of persons having epidemic respiratory infection who reacted maximally to intradermal injection of thermal antibody prepared from such strains and against cultures of D. pneumoniae, hemolytic streptococci, and Staphylococcus aureus. The results obtained are well illustrated in one such experiment shown in the Chart. It will be noted that the nonhemolytic streptococci and Staphylococcus aureus were far more resistant to each of the antibiotics than D. pneumoniae and hemolytic streptococci. In the case of penicillin, 200,000 units per milliliter of solution had less bactericidal action on the "pneumotropic" nonhemolytic streptococci and on Staphylococcus aureus than 0.2 units per milliliter of solution had on D. pneumoniae and hemolytic streptococci.

STUDY OF THE MILK SUPPLY

Owing to the sudden occurrence of the epidemic and to my past experience in similar outbreaks,[4] a study of the milk supply in relation to the outbreak was made. It was found that all whole and skim milk used at the hospital was supplied by one large dairy farm 20 miles distant from the hospital. Respiratory infections were also present among the personnel at the farm but were less severe than at the hospital. The technique of hand milking was found excellent. The milk from cows with diseased udders was discarded. The freshly obtained milk was promptly pasteurized by the standard method of heating to 145 F. for 30 minutes. It was promptly cooled after pasteurization by the open process as it flowed by gravity over refrigerated brass pipes. Most of it was then passed through a separator. The cream was used for making butter, and the skim milk and whole milk were collected in 10 gal. cans with tight-fitting covers. The filled cans were stored in a refrigerated room until transported to the hospital in an unrefrigerated truck. At the hospital the cans were again placed in a cold room kept constantly at 40 F. From the cold room at the hospital, the milk was in turn transported unrefrigerated in 10 gal. cans or in smaller amounts to the different wards for consumption. Cultures were grown on blood agar and nutrient agar and in serial dilutions of dextrose-brain broth from milk obtained in a sterile manner from 11 cows having normal udders, the udders of 2 cows having mastitis, 7 samples of pasteurized whole milk, and 12 samples of pasteurized skim milk. Some of these samples were obtained from milk from the 10 gal. cans at the farm immediately after pasteurization and some from milk after refrigeration at the hospital. The bacteria counts were comparable. Similar cultures were grown with negative results from material from swabbings from the insides of 10 gal. cans after they were washed and the insides sterilized by a jet of live steam.

It was found at the dairy that the mechanism for refrigerating the cold room in which the cooled pasteurized milk in 10 gal. cans was stored had broken shortly before the outbreak of the epidemic occurred at the hospital, during unusually warm winter weather. Repairs of the cooling unit were unavoidably delayed for several weeks.

Streptococci of the nonhemolytic type were obtained in large numbers on blood agar and nutrient agar, and Gram-negative and Gram-positive bacilli and micrococci grew in smaller numbers from all samples. The number of colonies that grew, except in the case of the milk obtained from diseased udders, was usually within the permissible bacteria count of present-day standards of health departments. However, the number of streptococci as determined by serial dilution cultures in dextrose-brain broth, a highly favorable medium for isolation of pathogenic streptococci, was far greater, often a thousandfold greater than indicated by mediums

4. (*a*) Rosenow, E. C., and Davis, D. J.: An Epidemic of Sore Throat Due to a Peculiar Streptococcus, J. A. M. A. **58**:773 (March 16) 1912; (*b*) A Study of Streptococci from Milk and from Epidemic Sore Throat, and the Effect of Milk on Streptococci, J. Infect. Dis. **11**:338-346, 1912. (*c*) Rosenow, E. C., and Moon, V. H.: On an Epidemic of Sore Throat and the Virulence of Streptococci Isolated from the Milk, ibid. **18**:69-71, 1915. (*d*) Rosenow, E. C., and von Hess, C. L.: An Epidemic of Septic Sore Throat Due to Milk, J. A. M. A. **68**:1305-1307 (May 5) 1917. (*e*) Rosenow, E. C.: Isolation from Milk Supplies of Specific Types of Green-Producing (Alpha) Streptococci and Their Thermal Death Point in Milk, Minnesota Med. **27**:550-556, 1944.

routinely used for bacteria counts, such as dilutions in nutrient agar. The wire used in making the serial dilutions was sterilized in a Bunsen flame between transfers. Streptococci outgrew Gram-negative gas-forming bacilli and Gram-positive bacilli and micrococci in low serial dilutions in dextrose-brain broth, and pure cultures of streptococci nearly always grew at the end-point of growth. Non-hemolytic streptococci usually grew in this medium at dilutions of 10^{-5} and sometimes at 10^{-9} even after standard pasteurization. This indicated that the streptococci concerned were highly resistant to heat. Accordingly, cultures were grown in one experiment from four samples of the milk after it was thoroughly mixed in the pasteurizer before and immediately after pasteurization at 145 F. for 30 minutes and before and after cooling by the open process. Streptococci grew in dextrose-brain broth at 10^{-5} from each of the four samples of milk before pasteurization, from three of four after pasteurization, and from two of four after pasteurization and cooling.

As a control, identical cultures were made of the milk after it was thoroughly mixed in the pasteurizer before and after pasteurization at 158 F. for 15 minutes and 30 minutes respectively. All the four samples before pasteurization revealed large numbers of colonies on agar and a pure culture of streptococci at 10^{-6} in serial dilutions in dextrose-brain broth. Pasteurization for 15 minutes did not suffice to kill all streptococci, but there was no growth in cultures made from the milk from the pasteurizer in any of the mediums after pasteurization for 30 minutes at the higher temperature. Few colonies of streptococci grew on blood agar and nutrient agar from two of four samples and at 10^{-1} dilution in dextrose-brain broth from four of the samples obtained from cooled milk and 10 gal. cans at the dairy and at the hospital.

In order to determine further whether or not the presence of such large numbers of streptococci in the milk after pasteurization by the usual method was owing to their high resistance to heat, six strains isolated from the milk after pasteurization at 145 F. for 30 minutes, three before and three after animal passage, and five strains isolated from material from the nasopharynxes of persons ill, two before and three after animal passage, were inoculated into autoclaved milk. The inoculated samples were refrigerated for 24 hours at 10 C. and then left to stand at room temperature for one hour, thus simulating what occurs as milk is commonly served. The samples in rubber-capped bottles were then pasteurized at 145 and 158 F. respectively for 30 minutes. The temperature inside of a control bottle filled with milk was checked meanwhile with a certified thermometer. Cultures were then made in dextrose-brain broth and in soft dextrose-brain agar, and the inoculated mediums and the samples of autoclaved milk inoculated with the streptococci and pasteurized were all incubated at 35 C. Streptococci were isolated from four of the six strains isolated from the milk supply, from all five strains isolated from material from persons ill and cultured in the brain-containing medium, and from three and five samples of incubated milk after pasteurization at the lower temperature. The average number of colonies that grew in shake cultures of dextrose-brain agar was 200,000 per milliliter and 69,000 per milliliter respectively. In sharp contrast, all samples of milk after pasteurization at 158 F. for 30 minutes proved sterile. On the basis of these findings it was suggested, and the authorities at the farm concurred, that henceforth the milk should be pasteurized at 158 F. for 30

minutes. Seemingly as a result, the incidence of influenza and other respiratory infections sharply diminished at the hospital. There have been no complaints among attendants or patients regarding the taste of the milk after pasteurization at the higher temperature to date, one and one-half years later. The incidence and severity of respiratory infections in the hospital this past winter were significantly less than previously, despite the fact that such infections were, among the general population, unusually prevalent and severe.

INOCULATION OF MICE

The results in mice inoculated with the streptococci isolated from persons ill and from the milk supply are summarized in Table 4. The incidence of pneumonitis following cerebral and nasal inoculation and the incidence of pleuritis following intraperitoneal inoculation were exceedingly high and comparable for the strains

TABLE 4.—*Results in Mice Following Cerebral and Nasal or Peritoneal Inoculation with Streptococci Isolated from the Nasopharynx of Persons Having Influenza and from the Milk Supply**

				Mice							
								Streptococci from Pleural Exudate		Streptococci from Pneumonic Lungs	
Material Inoculated	Source of Material	Inoculation	Strains Inoculated	Inoculated	Died, %	Pleuritis, %	Pneumonitis, %	Cultured	% +	Cultured	% +
Pure cultures of streptococci from the end-point of growth of serial dilution cultures in dextrose-brain broth	Nasopharynx of persons ill with influenza	Cerebral and nasal	36	61	30	0	**77**	..	...	23	100
		Peritoneal	15	15	53	**66**	**73**	10	100	10	100
		Total	36	76	**34**	..	**73**	10	100	33	100
	Milk supply	Cerebral and nasal	34	57	19	0	**70**	..	...	23	87
		Peritoneal	14	20	45	**50**	**65**	13	100	13	100
		Total	34	77	**26**	..	**69**	..	...	46	100
	Nasopharynx of controls	Cerebral and nasal	38	166	23	0	19	..	...	..	...

* The bold-face numbers indicate specificity.
† Persons ill with diseases other than of the respiratory tract.

isolated from stricken patients and from the milk. The mortality was slightly higher following inoculation with strains from the patients than from the milk. Isolations from turbid pleural fluid and from pneumonic lungs in both groups were virtually 100%.

AGGLUTINATION OF THE STREPTOCOCCUS

The results of agglutination tests with the blood serum of patients according to the duration of the disease, the cutaneous reactions indicating antigen, and the streptococci isolated from serum of persons in whom the reactions to intradermal injection were high or low, respectively, are summarized in Table 5. A consistent correlation between the agglutination titer and the cutaneous reaction is strikingly shown. The blood serum from persons who reacted strongly to the thermal antibody agglutinated strains isolated from persons who reacted strongly to the skin test to a far greater degree than strains isolated from persons whose cutaneous reactions were low, and vice versa. Moreover, correlation between cutaneous reactions and the response or nonresponse to penicillin treatment shown

in Table 2 is manifested also in the agglutination titers of the respective serums. The streptococci isolated from the milk were also agglutinated by the serums of patients in direct proportion to the duration of the disease.

TABLE 5.—*Agglutination Titer for Streptococci Isolated During the Current Epidemic from the Serum of Schizophrenic Persons Convalescing from Influenza in Relation to the Cutaneous Reactions and Duration of Disease**

Serum from Patients According to Cutaneous Tests and Duration of Disease and from Contacts		Duration of Disease, Days	Serums: Pools	Serums: Cases	Agglutination Titer in % of Total Possible at 4 5-Fold Dilutions of 1-5 to 1-625 of Convalescent Serums for Streptococci Isolated from: Persons Having Influenza in Whom the Cutaneous Tests Indicating "Influenzal" Streptococcic Antigen Were: High: Not in Hospital (3-16)†	High: In Hospital (3-16)	Low: In Hospital (4-21)	High Did Not Respond to Penicillin (2-9)	Low Responded to Penicillin (2-9)	Milk Supply (7-46)
Serums of persons ill with influenza in whom the cutaneous test indicating streptococcic antigen was	High	1-6	9	40	42	41	33	32	35	29
	High	7-21	6	30	**69**	**57**	44	**61**	45	**54**
	Low	1-5	4	21	34	42	38	27	47	24
	Low	6-14	2	8	47	51	**76**	46	**67**	**57**
Schizophrenic contacts in whom the skin test was	Moderate	...	3	17	**54**	45	35	**55**	24	23

* The bold-face numbers indicate specificity.
† The numbers in parentheses indicate the number of suspensions and strains of streptococci, respectively.

TABLE 6.—*Agglutination Titer of Streptococcic Thermal Antibody and Antiserum for Streptococci Isolated from the Nasopharynx of Persons Having Influenza and from the Milk Supply During Current Epidemic According to the Cutaneous Reactions**

Type of Streptococcic Antibody and Antiserum		Agglutination in % of Total Possible at 4 5-Fold Dilutions of 1-26 to 1-2,500 of Thermal Antibody and Antiserum Prepared from Streptococci Isolated Previously in Studies of Influenza, Schizophrenia, and Poliomyelitis for the Streptococci: Cutaneous Reactions: High: Not in Hospital (3-10)†	High: In Hospital (5-18)	Low: In Hospital (8-26)	Milk Supply (7-34)
Thermal antibody prepared in vitro from	Nonhemolytic streptococci isolated in studies of Epidemic respiratory infection	**72**	**75**	45	**65**
	Nonhemolytic streptococci isolated in studies of Schizophrenia	14	44	29	17
	Nonhemolytic streptococci isolated in studies of Epidemic poliomyelitis	14	19	20	24
	D. pneumoniae, types I, II, III	19	26	38	37
	Control, NaCl solution at pH of thermal antibody	8	22	15	13
Natural antibodies in antiserum prepared in horses with	Nonhemolytic streptococci isolated in studies of Epidemic respiratory infection	**52**	**49**	37	**47**
	Nonhemolytic streptococci isolated in studies of Schizophrenia	16	26	27	9
	Nonhemolytic streptococci isolated in studies of Epidemic poliomyelitis	19	21	6	8
	D. pneumoniae, types I, II, III	29	29	17	10
	Control, normal horse serum	19	15	0	11

* The bold-face numbers indicate specificity.
† The numbers in parentheses indicate the number of suspensions and strains of streptococci respectively.

The agglutination titers of thermal antibody and antiserum prepared from streptococci isolated in studies of respiratory infection, schizophrenia, epidemic poliomyelitis, and D. pneumoniae are shown in Table 6. A high degree of specificity for streptococci isolated from persons ill and from the milk is shown. Again the

agglutination titer was far higher for strains isolated from persons having respiratory infections in whom the cutaneous reactions to antibody indicating antigen were high than for strains isolated from persons whose cutaneous reactions were low.

COMMENT AND SUMMARY

An epidemic of influenza which occurred in a large hospital and was apparently due to a pasteurized milk supply is reported. The infecting organism proved to be a nonhemolytic Streptococcus highly resistant to heat and having high pneumotropic virulence. Thermal antibody prepared with heat alone [1] from nonhemolytic streptococci isolated previously in studies of epidemic respiratory infection and from persons stricken in this outbreak proved diagnostic of such infection on intradermal injection, and the corresponding streptococcic antigen served as a measure of antibody. Reactions indicating antigen were maximal at the onset of the disease and gradually diminished as recovery ensued. Reactions indicating antibody were minimal early in the disease and increased with recovery, and both reactions to repeat tests disappeared after recovery. Therapeutic injections of streptococcic thermal antibody prepared with heat and hydrogen peroxide [2] caused a sharp drop in antigen and a corresponding rise in antibody and usually clinical improvement in persons not receiving penicillin. The drop in antigen and rise in antibody and clinical response to therapeutic injection of antibody, for reasons obscure, did not occur in persons receiving penicillin. The Streptococcus isolated from persons reacting strongly to "respiratory" streptococcic antibody in cutaneous tests was found highly resistant to penicillin in vitro, and full doses of penicillin had little or no apparent effect in treatment. The Streptococcus isolated from persons reacting slightly to "respiratory" antibody was found highly sensitive to penicillin, and striking clinical improvement followed the intramuscular injection of penicillin.

The results of cutaneous tests made with antibody and antigen in persons having influenza and the results of therapeutic injection of antibody in this outbreak were similar to those obtained in studies made over a period of five years to date in a large number of persons having epidemic respiratory infections.[4d] A strong cutaneous reaction to antibody indicating specific streptococcic antigen and a sharp increase in antibody and clinical improvement after therapeutic injection of "respiratory" antibody occurred in well over 90% of the patients, and in all of them the infecting Streptococcus, according to the results of studies in this epidemic, should have been highly resistant to penicillin, streptomycin, and aureomycin. The cutaneous test for specific antigen in skin or blood should prove valuable in determining immediately whether antibiotics or specific streptococcic antibody is indicated in treatment. If the cutaneous reaction is pronounced, streptococcic antibody is indicated; if slight or negative, antibiotics should be given.

JUVENILE NASOPHARYNGEAL ANGIOFIBROMA IN THE FEMALE

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LOS ANGELES

JUVENILE nasopharyngeal angiofibroma is a rather rare tumor. Several series of a sufficient number of cases have been reported.[1] In the series of New and Figi and Shaheen a few reports of the tumors occurring in females were included. The latter point is stressed because the occurrence of such neoplasms in females has been challenged by Martin, Ehrlich, and Abels [1c] in their paper on this subject published in 1948. They were of the opinion the neoplasm had a relationship to the male endocrine glands and that the authenticity of true juvenile nasopharyngeal angiofibroma in the female was questionable. They presented several criteria for the diagnosis of such true neoplasms.

The girl whose case is presented had not yet reached the age at which such neoplasms may tend to regress spontaneously. Other evidence, the appearance and location of the tumor, the clinical course, and the biopsy specimen as examined independently by three capable pathologists, supports the diagnosis of juvenile nasopharyngeal angiofibroma.

Juvenile nasopharyngeal angiofibroma is a benign, firm, neoplasm found primarily in the nasopharynx of young adults. It is characterized by its vascular fibrotic nature. Though not malignant, it may invade by direct extension.[2] Ulceration of the tumor due to inflammation or trauma accounts for the repeated epistaxis, or hemorrhage, so often complicating in conservative therapy. Onset of this neoplastic growth, according to Martin, Ehrlich, and Abels,[1c] always occurs during adolescence. Spontaneous regression is said to occur frequently at sexual maturity or adulthood. A few writers, as Allan,[3] have reported occasional malignant degeneration.

REPORT OF A CASE

A girl, aged 13, was first seen in the Nose and Throat Service of the California Hospital in October, 1950. She complained of nasal respiratory difficulty which had increased to the point of causing some distress and some associated mild dysphagia. Onset of nasal obstruction was

1. (*a*) New, G. B., and Figi, F. A.: Ann. Otol. Rhin. & Laryng. **34**:191 (March) 1925. (*b*) Shaheen, H. B.: J. Laryng. & Otol. **45**:259-264, 1930. (*c*) Martin, H.; Ehrlich, H. E., and Abels, J. C.: Ann. Surg. **127**:513-536 (March) 1948. (*d*) Dabney, V.: Laryngoscope **22**:967, 1912. (*e*) Som, M. L., and Neffson, A. H.: Ann. Otol. Rhin. & Laryng. **49**:211-218 (March) 1940. (*f*) Friedberg, S. A.: Vascular Fibromas of the Nasopharynx (Nasopharyngeal Fibroma), Arch. Otolaryng. **31**:313-326 (Feb.) 1940. (*g*) McFarland, J.: Lancet **2**:1154 (Dec. 17) 1949. (*h*) Brown, J. M.: Ann. Otol. Rhin. & Laryng. **56**:294-297 (June) 1947. (*i*) Kerwin, R. W.: Juvenile Nasopharyngeal Angiofibroma, A. M. A. Arch. Otolaryng. **53**:397-405 (April) 1951.

2. Eggston, A. A., and Wolff, D.: Histopathology of the Ear, Nose and Throat, Baltimore, Williams & Wilkins Company, 1947.

3. Allan, W. B.: Nasopharyngeal Fibroma, Arch. Otolaryng. **19**:216-223 (Feb.) 1934.

placed at about two years previously. There was no history of epistaxis or hemoptysis. Her speech had become somewhat nasal. Her menses had begun at the age of 11 years. There were no complaints referable to any organ system other than the upper respiratory tract.

Physical Examination.—Examination of the nose revealed a smooth, bluish gray, finger-like mass filling the left nasal airway as far forward as the vestibule. On manipulation of this mass, after nasal shrinkage to determine its point of fixation, some bleeding resulted. Anterior rhinoscopy showed the right airway clear; palpation with a blunt probe, however, revealed an obstruction at approximately the depth of the posterior choana.

In the left oropharynx there was seen a prominent, smooth, pink, encapsulated mass behind the left tonsillar fossa, extending into the hypopharynx. Elevation of the soft palate as high as possible with the Love retractor revealed this mass to be merely the apex of a pear-shaped tumor filling the entire nasopharynx. Digital manipulation demonstrated the mass to be

Fig. 1.—Lateral view showing sharply circumscribed pharyngeal mass.

rubbery hard and immovable in the nasopharynx, with the result that the point of attachment could not be determined. Estimation of the true size of this mass was difficult, but it was approximately 3.5 cm. at the widest diameter seen and approximately 5.5 cm. from the tip in the hypopharynx to the highest point visualized. No areas of ulceration or necrosis were found.

The tonsils were small, pale pink in color, and no masses could be palpated in them. The tongue, hypopharynx, and larynx appeared uninvolved. No regional lymph nodes could be seen or palpated. The ear drum membranes were gray-white in color, retracted, and the light reflex was diminished. Hearing was normal for the whispered-voice test. There was no evidence of nasal or facial bony deformity.

Roentgenologic studies indicated the pharyngeal mass to be sharply circumscribed, and it was most clearly seen in the lateral view (Fig. 1). The left maxillary sinus appeared thickened. Some thickened mucous membrane was seen in the ethmoid sinuses. The frontal and sphenoid sinuses appeared not to be involved. No evidence of bony involvement could be seen in any area associated with the nasopharynx.

Biopsy.—In the hospital with the patient under local anesthesia the tip of the pear-shaped mass was removed with a snare and the raw area cauterized. Bleeding was not profuse, and the raw surface healed promptly. Stained sections from the biopsy were submitted independently to three well-qualified pathologists, having in mind the controversy over this neoplasm. The first pathologist, Dr Russell H. Fisher, reported that the structure resembled mature granulation tissue, being composed of radial blood vessels in a fibrocytic tissue, the fibers of which were arraigned perpendicular to the vessels and parallel to the surface. In this fibrillar tissue there were some cells with stellate cytoplasm and large vesicular nucleus with large nucleolus. Lymphocytes, plasma cells, eosinophils, and mast cells were scattered throughout the tissue and concentrated just beneath the surface. The surface epithelium was of a hyperplastic respiratory type. The second pathologist, Dr. Angus Wright, reported that the rounded surface was covered by pseudostratified columnar epithelium, some of it ciliated. The underlying tissue was loose, vascular, fibrous connective tissue. At the base of the section, that is, in its deepest

Fig. 2.—Microscopic view of structure.

portion, the fibrous tissue was more compact. Both there and in the looser tissue there were large cells which were elongated and sometimes stellate. These had relatively large hyperchromatic nuclei; sometimes they appeared to be multinuclear. Also there are scattered lymphocytes, plasma cells, and near the surface some eosinophils. The third pathologist, Dr. John W. Budd, gave a similar report. All three pathologists were of the opinion the structure was identical with that called juvenile nasopharyngeal fibroma (Fig. 2).

Clinical Course During Therapy.—Since the tumor caused comparatively little discomfort and since epistaxis had not occurred, immediate surgical excision, with the attending risk of hemorrhage, was not deemed emergent. A thorough physical examination, including a gynecologic survey, was done. While the girl was found somewhat less than robust, she was credited with usual sexual development for her age. No constitutional physical defect was uncovered. Androgen therapy was advised against as a primary therapeutic measure, considering the possible hormonal and psychic disturbances; consequently, x-ray therapy was chosen for initial use.

A total of 1,650 r in air was given through a 10 by 10 cm. port to each side of the pharynx, constituting a dose to the tumor of about 2,400 tissue roentgens. The following factors, 250 kvp, 1 mm. Cu and 1 mm. Al for added filtration, and a half-value layer 1.95 mm. Cu, were used.

Six weeks after x-ray therapy was initiated, the neoplasm had receded high into the epipharynx (Fig. 3). It still was not movable by digital manipulation. The projection in the left side of the nose, as well, had receded and shrunken. The entire mass appeared whiter and firmer, like any postradiation tissue. The Eustachian tubes inflated easily, and the normal drum membrane markings had returned. Symptomatically, too, much improvement was evident. Nasal respiration was free through the right side. Pressure symptoms in the pharynx had disappeared.

Fig. 3.—Receded neoplasm high in epipharynx six weeks after x-ray treatment was begun.

It has been six months to date since this girl was first seen. She has had two mild upper respiratory infections, both of which have yielded promptly to conservative therapy. Further therapy may include implantation of radium seeds. Surgical excision will be delayed as long as possible.

SUMMARY

A case of juvenile nasopharyngeal angiofibroma in a girl is presented. A short survey of the literature on the neoplasm is given.

727 W. Seventh St.

TREATMENT OF INTRINSIC CARCINOMA OF THE LARYNX IN PATIENTS WITH PULMONARY TUBERCULOSIS

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AND
JOHN C. LARKIN Jr., M.D.
MEMPHIS

ALTHOUGH it would seem obvious that a far from rare condition such as carcinoma of the larynx must coexist in a few of the many patients with pulmonary tuberculosis, such cases rarely have appeared in our medical literature. Whenever this combination is mentioned, the tuberculosis is considered to be a contraindication to radical resection of the carcinoma.[1] Yet the early surgical removal of an intrinsic carcinoma of the larynx and the affected vocal cord is believed to result in the highest percentage of cures.[2] Irradiation alone is considered best only when the growth is extrinsic.

Our experience suggests that owing to the availability of streptomycin, it is now possible to offer patients with active tuberculosis who also have carcinoma of the larynx the benefit of surgical resection of the cancer with comparative safety, as regards both operative mortality and postoperative complications. In this paper, we record the detailed case reports of three patients with carcinoma of the larynx and active pulmonary tuberculosis treated at Kennedy Veterans Administration Hospital during the past three years.

REPORT OF CASES

CASE 1.—F. M., a 57-year-old Negro male tailor, was admitted to Kennedy Veterans Administration Hospital on Dec. 30, 1947, with a history of intermittent hoarseness for four years which had become progressively severer during the past four to five months so that at the time of hospitalization he could barely speak. Lately he had also noticed a productive cough with intermittently blood-streaked sputum, night sweats, dyspnea, pain in the right chest and right arm, and a 15 lb. (6.8 kg.) weight loss.

On physical examination the patient was found to be hoarse and acutely and chronically ill. His larynx appeared enlarged and bulged externally. His chest showed diminished resonance over both apical regions, particularly in the right, and there was bronchovesicular respiration.

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Reviewed in the Veterans Administration and published with the approval of the Chief Medical Director. The statements and conclusions published by the authors are the result of their own study and do not necessarily reflect the opinion or policy of the Veterans Administration.

1. Ballenger, W. L., and Ballenger, H. W.: Diseases of the Nose, Throat, and Ear: Medical and Surgical, ed. 7, Philadelphia, Lea & Febiger, 1938, p. 566. Spencer, F. R., in Jackson, C., and Jackson, C. L.: Diseases of the Nose, Throat, and Ear, Including Bronchoscopy and Esophagoscopy, Philadelphia, W. B. Saunders Company, 1945, p. 788.

2. Heatly, C. A., in Cecil, R., and others: Textbook of Medicine, ed. 7, Philadelphia, W. B. Saunders Company, 1948, p. 917.

Dry inspiratory wheezes and coarse expiratory rales were scattered throughout both lungs. The results of the remainder of the physical examination were essentially normal, with no definite evidence of lymphadenopathy. On admission, the patient's temperature varied around 100 F.

The blood count revealed a slight anemia. The results of blood serum tests for syphilis were positive in moderately high titer. The sputum was positive on concentration and culture for the tubercle bacilli. A chest roentgenogram revealed mottled infiltrations throughout the upper thirds of both lung fields. There was a 4 cm. radiolucent area in the first left anterior interspace (Fig. 1).

A laryngoscopy on Jan. 5, 1948, revealed both arytenoids to be mildy swollen. The left false cord was greatly swollen, covering the true cord. In the region where one would expect to see the middle portion of the left true cord, there were several small granulomas. No airway could be seen, partly owing to the overhanging swollen left ventricular band. On phonation there was slight movement of the right arytenoid, none of the left.

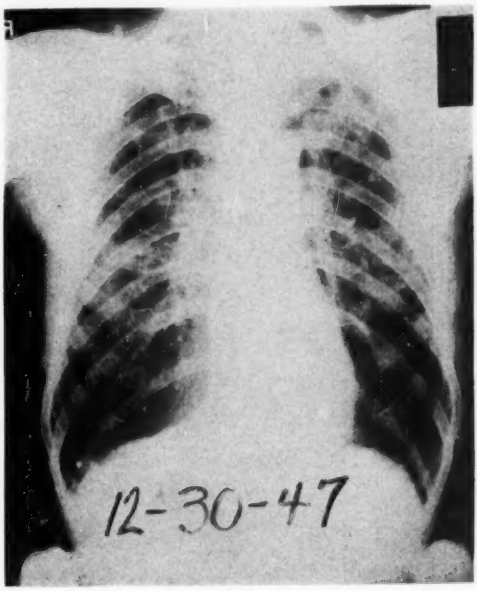

Fig. 1 (Case 1).—Chest roentgenogram on admission revealing bilateral infiltration with cavitation on the left.

On January 6, an elective tracheotomy was performed and afforded slight relief of the respiratory distress. On January 7, the patient was given penicillin, 50,000 units every three hours, as therapy for his syphilis. A biopsy of the laryngeal mass on January 14 revealed squamous cell carcinoma. Because early death was more likely from the cancer of the larynx than from the pulmonary tuberculosis, a laryngectomy was recommended under the protection of streptomycin, the administration of which was started on January 20, 0.5 gm. twice daily.

On February 6, a total laryngectomy was done by Dr. Ralph Bowers, and the pathological study revealed a squamous cell carcinoma, Grade III (Fig. 2). Postoperatively, the convalescence was uneventful. The surgical wound healed per primam. There was a low-grade fever, but the temperature returned to normal by February 20. On February 24, a chest roentgenogram showed improvement of the tuberculosis, with slight clearing in the left midlung field and slight diminution in the size of the cavity in the left upper lung field. There was a diminution of the cough and amount of sputum. A weight gain occurred following surgery. Penicillin therapy was discontinued on February 24, but use of streptomycin was continued until April 20.

About the middle of March, the patient's temperature became slightly elevated, up to a 100 F. Growing nodules were noted in the left side of the neck, one of which on removal and pathological section revealed undifferentiated squamous cell carcinoma. The patient began to lose weight and in May was permitted to go home on a month's farewell leave. On his return on June 1, the tracheal opening had narrowed because of encroachment by a large mass in the lower right side of the neck and smaller masses in the left side. There were no other evidences of metastases. A chest roentgenogram revealed the appearance of marked generalized emphysema. There was a large ovoid radiolucent area in the left apex which was thought to

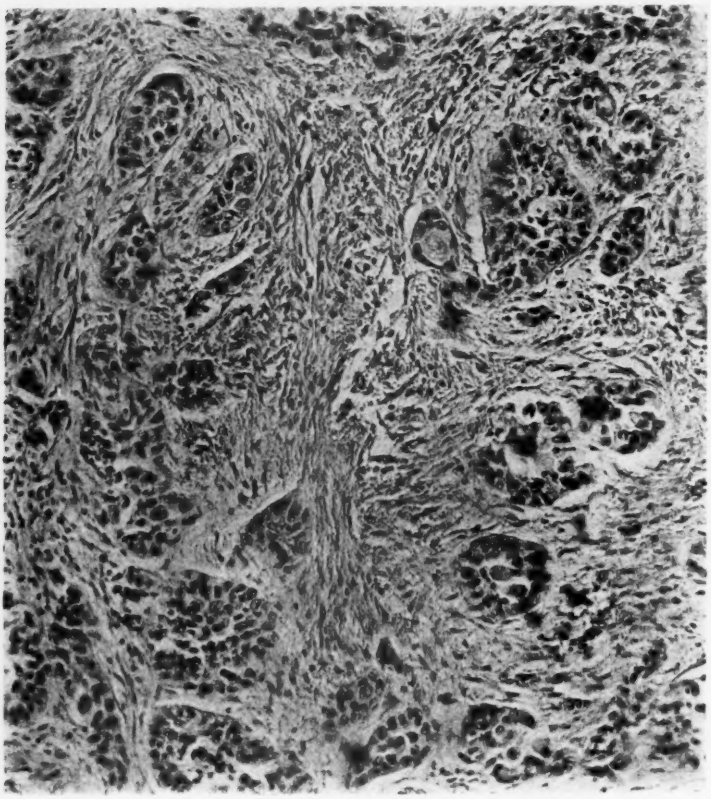

Fig. 2 (Case 1).—Pathological section made from removed larynx showing squamous cell carcinoma, Grade III.

represent an emphysematous bulla; otherwise the status of the parenchymal infiltration did not appear changed. He complained of difficulty in breathing and swallowing during this time and gradually became weaker. On June 20, he died. A request for autopsy was refused, but it was apparent that the laryngectomy had been performed too late to prevent recurrence of the cancer.

Case 2.—J. M., a 56-year-old white male bartender and chronic alcoholic, who gave a history of known pulmonary tuberculosis since 1933 and lobar pneumonia in November, 1945, followed by empyema on the right which was treated by rib resection and drainage, stated that he felt well until January, 1948, when he noticed a productive cough with occasional blood-streaked

sputum, dyspnea, and weakness. He was admitted to another hospital in August, 1948, where his sputum was found to be positive for tubercle bacilli. He was treated with bed rest until October, 1949, when he was transferred to Kennedy Veterans Administration Hospital for a proposed thoracoplasty.

On physical examination, he was seen to be a well-developed, well-nourished, afebrile white man. He spoke in a hoarse voice, which he said he had noted during the winter months for the past 15 years. There was a large central perforation of the nasal septum. The chest showed a nontender scar over the eighth right rib posteriorly. Whispered voice sounds and bronchial breathing were increased over the right apex. There were fine and coarse dry rales throughout the entire chest. The liver edge was palpable three fingerwidths below the right costal margin. The spleen was not palpable. The results of the remainder of the physical examination were not significant, except for a right inguinal hernia.

The complete blood count and urinalysis showed normal results, and results of blood serum tests for syphilis were negative. The cephalin flocculation test showed a 3 plus flocculation

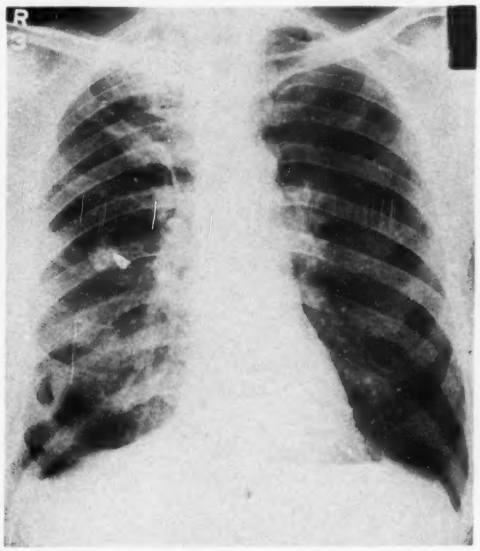

Fig. 3 (Case 2).—Chest roentgenogram on admission revealing fibrocavitary lesions of the right lung.

in 48 hours. The results of the thymol turbidity and the sulfobromophthalein tests were normal. The total serum protein was 7.7 gm. per 100 cc. with 4.0 gm. of globulin present. The sputum revealed tubercle bacilli on concentration and culture. A chest roentgenogram showed a diffuse mottled infiltration in the right upper lung field extending from the apex down to the first interspace, with a radiolucent area in the region of the right third posterior rib. There was also a discrete minimal lesion in the right midzone and some blunting of the right costophrenic sinus (Fig. 3). On Nov. 2, 1941, an indirect laryngoscopy revealed that the left ventricular band was ulcerated and covered with a grayish white dirty membrane. There was some limitation of motion of the left arytenoid. At the previous hospital, in November, 1948, a laryngoscopy had revealed grayish deposits on the left ventricular band, but a punch biopsy showed only stratified squamous epithelium. On the evidence, we considered that the laryngeal lesion was due to tuberculosis, and the patient was given streptomycin, 1 gm. twice weekly along with 12 gm. of paraaminosalicylic acid daily. Because the expected improvement did not follow, a biopsy of the laryngeal lesion was taken on Jan. 31, 1950, which on pathological section showed a squamous cell carcinoma of the larynx, Grade I. The chest roentgenogram at this time showed

slight clearing of the infiltrate in the right upper lung field, but the sputum was still positive for the tubercle bacilli.

On February 23, a total laryngectomy was performed by Dr. Sydner Maiden, and the specimen taken confirmed the biopsy diagnosis (Fig. 4). Streptomycin therapy was continued, and the paraaminosalicylic acid was given through a Levine tube. Penicillin was also administered. On the fourth postoperative day, the streptomycin dosage was increased to 1 gm. daily, but it was necessary to discontinue the paraaminosalicylic acid because of abdominal distress. The patient was fed through the Levine tube, but lost about 15 lb. (6.8 kg.) in weight. In addition, a tracheoesophageal fistula developed. On April 16, the fistula was closed surgically and healed

Fig. 4 (Case 2).—Pathological section made from resected larynx revealing squamous cell carcinoma, Grade I.

well subsequently. Streptomycin therapy was discontinued on April 21. Roentgenograms showed that the condition of the chest remained stable during this period, and the sputum aspirated through the tracheotomy tube was negative on concentration and culture for the tubercle bacilli. Further convalescence was uneventful, and it became possible to remove the tracheotomy tube for progressively longer periods of time until it was inserted only during the night. There were no signs of recurrence of the malignant growth.

Because his condition seemed satisfactory, the patient was permitted to go on a three-day pass during the Christmas holidays. He unfortunately spent this time in an alcoholic debauch. Immediately afterward, in January, 1951, an increase in the infiltrative process in the right upper lobe was noted with probable cavity formation. He felt well, however, and was afebrile,

and the material aspirated from the tracheotomy opening remained negative even on culture for tubercle bacilli. On February 3, administration of streptomycin, 1 gm. twice weekly along with 12 gm. paraaminosalicylic acid daily, was again started. A pneumoperitoneum also was attempted but was unsuccessful owing to the presence of a fixed diaphragm on the right. Around the middle of April, the patient began to expectorate small amounts of blood from the tracheotomy opening—whether from the trauma involved in using the tracheotomy tube at night or from the active pulmonary lesion was not clear. The patient became discouraged and requested transfer to a hospital nearer his home in Philadelphia. When that was not forthcoming, he left the hospital without our knowledge. He had gained about 45 lb. (20.4 kg.) while in the hospital. The reactivation of tuberculosis had occurred 11 months after the laryngectomy.

CASE 3.—T. G., a 57-year-old white man, entered Kennedy Veterans Administration Hospital on Jan. 10, 1950, with multiple complaints. On a previous admission on Feb. 8, 1947, for a

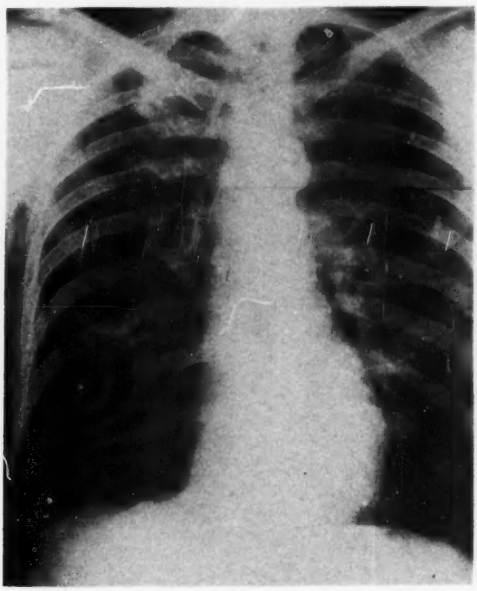

Fig. 5 (Case 3).—Chest roentgenogram on admission revealing bilateral infiltration.

right herniorrhaphy, he had also described digestive symptoms. Gastrointestinal serial roentgenograms at that time suggested an infiltrating mass of the stomach, which was verified by gastroscopy. Laparotomy and pathological study of a biopsy specimen indicated a malignant lymphoma. Irradiation therapy was given the patient over the right upper abdomen, and he was discharged. When he was reexamined on Jan. 16, 1948, a chest roentgenogram demonstrated nodular and linear infiltrates involving the right upper lung field. Sputum examinations, however, were negative for tubercle bacilli. Gastrointestinal serial roentgenograms showed regression of the gastric mass. In the fall of 1949, hoarseness developed which gradually cleared. In December, 1949, the hoarseness recurred, and the patient also experienced cough, chest pain, headache, and fever, which persisted until the time of rehospitalization. He also complained of severe pain in his right scrotum.

On physical examination the patient was seen to be a well-developed, well-nourished, febrile white man who appeared to have considerable pain from an infected hydrocele. The lungs were clear to percussion and auscultation. Well-healed scars were present in the epigastrium and right inguinal region, but there were no palpable masses or enlarged organs present in the

abdomen. The right half of the scrotum was very tender and enlarged and the right epididymis hardened and tender. The remainder of the physical examination showed nothing significant.

The blood count showed a mild leucocytosis. The sputum was positive on concentration and culture for the tubercle bacilli. A chest roentgenogram demonstrated a mottled infiltration in the right upper lung field extending down to the level of the sixth anterior rib. A well-demarcated oval density was present in the third left anterior interspace, measuring approximately 2 by 1 cm., with another well-demarcated and somewhat denser round lesion overlying the fourth left anterior rib and measuring 3 by 2 cm. (Fig. 5). Gastrointestinal serial roentgenograms at this time failed to reveal any abnormality of the esophagus, stomach, or duodenum.

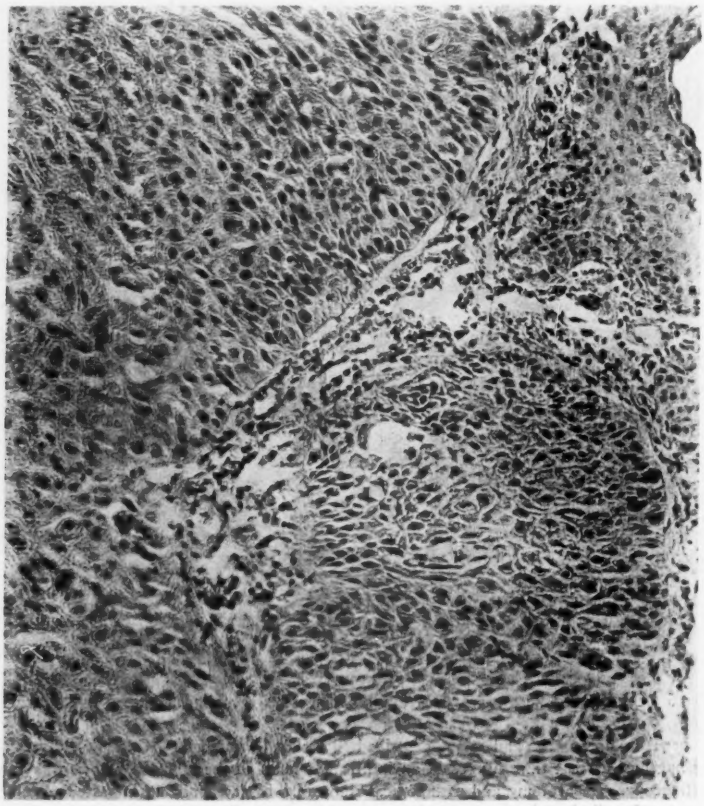

Fig. 6 (Case 3).—Pathological section made from resected larynx showing squamous cell carcinoma, Grade II.

A culture of the hydrocele fluid yielded Staphylococcus aureus and Escherichia coli. The patient was treated with penicillin and sulfadiazine with partial defervescence and partial subsidence of the scrotal swelling and tenderness. On Jan. 31, 1950, a right hydrocelectomy was performed, from which the patient made an uneventful recovery. His temperature became normal on February 4 and remained so subsequently except for a short elevation about a week later.

A laryngoscope performed on February 10, revealed a whitish mass on the left vocal cord extending into the glottis and across the commissure to involve a portion of the right cord anteriorly. A biopsy taken of the lesion on February 24 revealed a squamous cell carcinoma,

Grade II (Fig. 6). On February 27, administration of streptomycin was started, 1 gm. daily, along with paraaminosalicylic acid, 12 gm. daily, to prepare the patient for a total laryngectomy, which was performed on March 9 by Dr. Sydner Maiden. Just prior to and following surgery he received penicillin, the administration of which was continued until April 4. Streptomycin had been continued during the postoperative period, but paraaminosalicylic acid was discontinued for about 10 days and then administered along with the tube feeding. After the sutures were removed from the stoma, there was a slight separation of the wound in the upper portion of the stoma, probably due to retraction from the action of the neck muscles. There was no evidence of fistula formation. With local measures the wound healed promptly.

Roentgenograms showed that the chest condition remained stable, although material aspirated from the trachea was still positive for tubercle bacilli. A pneumoperitoneum was attempted in June, but was abandoned because of severe discomfort. The streptomycin and paraaminosalicylic acid were discontinued June 27. There was no recurrence of the laryngeal malignant growth or any evidence of metastasis. The chest roentgenograms continued to show slight improvement. The material aspirated from the tracheal opening became persistently negative on culture for tubercle bacilli in October.

COMMENT

In treating laryngeal carcinoma in patients with pulmonary tuberculosis, two complications are feared—failure of the operative site to heal and spread of the pulmonary tuberculosis. Because the intact larynx is frequently involved as a complication of active pulmonary tuberculosis, the possibility of a tuberculous process arising in a raw area following a laryngectomy appears threatening. This did not occur in any of the three above-reported cases. One patient did have a tracheoesophageal fistula, but this also occurred in a few other patients in the absence of pulmonary tuberculosis. It healed with further surgical measures. In another the stoma temporarily opened but soon responded to local measures. There was no evidence of tuberculous infection in the operative wound in any of the patients, all of whom had sputum containing the tubercle bacilli.

As for the postoperative spread of the tuberculosis, in all three patients the pulmonary condition, instead of becoming worse following the laryngectomy, improved. In Case 2, in which there was a relapse of tuberculosis 11 months after the laryngectomy, the relapse seemed definitely related to an alcoholic spree and to the relapsing nature of tuberculosis. In Case 1 it was recognized that perhaps a laryngectomy would no longer prevent the development of metastases, but the laryngectomy seemed justified because it would, at the least, afford the patient a less painful death. Following the laryngectomy, the pulmonary tuberculosis seemed to improve, and even when the patient returned to the hospital from a leave in a terminal state the pulmonary tuberculosis appeared little changed roentgenologically except for the presence of marked generalized obstructive emphysema. In Case 3 there was slight clearing of the pulmonary infiltrate roentgenologically, and the secretions aspirated from the tracheal opening eventually became negative for the tubercle bacilli, even on culture. In both Case 2 and Case 3 considerable weight was gained after a temporary loss postoperatively.

SUMMARY AND CONCLUSIONS

1. Laryngectomy for carcinoma of the larynx can be safely performed in the presence of active pulmonary tuberculosis when the latter is adequately controlled by streptomycin.

2. Three cases are reported in which this procedure was performed with good local healing of the operative site and absence of progression of the pulmonary tuberculosis.

REPOSITIONING THE MANDIBLE IN CASES OF OBSTRUCTIVE (LOW TONE) DEAFNESS AND TINNITUS

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A GREAT deal has been written about repositioning the mandible in cases of obstructive deafness and tinnitus. The problem has been studied by dentists, otologists, anatomists, and physiologists.

Costen and other investigators have reported their findings as to the validity of lost vertical dimension as a cause of obstructive deafness and tinnitus. Vertical dimension may be defined as the proper relationship between the maxilla and the mandible. There have been many opinions both pro and con, and each investigator has made a strong case for his side of the question. The fact remains, however, that dentists have been able in many cases, by the closest cooperation with the otologist, to carry through to a successful conclusion relief of tinnitus and deafness of the obstructive type by proper adjustment of the bite or, as we shall refer to it, by proper repositioning of the mandible. The literature in dentistry and otology contains many such reports.

There has been so much confusion hovering about this controversial subject that it prompted the editors of the *Journal of the American Dental Association*[1] some years ago to issue a warning against the promiscuous opening of the bite in cases of obstructive deafness. There are, I believe, two pertinent reasons as to why this confusion exists. First, all the problems involved in hearing are not too well understood. Exactly how we hear has never been scientifically established. When the patient presents himself because of impairment of hearing, the otologist must endeavor to determine the seat of the lesion—whether it is in the middle ear and thereby interferes with sound conduction or whether it is in the internal ear or its central connections and thereby interferes with sound perception. In some cases the differential diagnosis is comparatively easy; in others, difficult, and in still others, impossible.[2]

The functional tests undertaken by the otologist to determine the amount and type of hearing loss include the voice, the watch, the tuning fork, and the electric

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Read before a meeting of the Rhode Island State Dental Society, Providence, R. I., Jan. 16, 1951.

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1. Opening of the Bite, Editorial, J. Am. Dent. A. **25**:954 (June) 1938.

2. Blumer, G.: The Practitioners Library of Medicine and Surgery: Volume 11. Eye, Ear, Nose and Throat, New York, D. Appleton-Century Company, Inc., 1937.

audiometer. The audiometer is by far the most accurate in determining the thresholds of auditory acuity, but it is certainly not a panacea for the difficulties of otologists interested in deafness.

Many problems of deafness are awaiting solution. In no field of legal medicine is there perhaps so great a variation of opinion as in that of the compensation for occupational deafness. It is quite obvious, then, why, from the otologists' point of view, not all otologists are ready to accept the probability that obstructive deafness of the middle ear may in some cases be relieved by repositioning the mandible.

The causes of tinnitus, a symptom manifesting itself by ringing or buzzing sounds in the head, are not well understood. Its cause or causes are not known, and there is no definite way in which to treat this condition. Otologists tell us that the cause or causes of this symptom, if they persist, may eventually lead to deafness. A few otologists [3] have been pioneers in the bite-opening problem as related to obstructive deafness and tinnitus.

Second, from the dentists' point of view we speak of opening the bite to relieve obstructive deafness and tinnitus. How much shall we open the bite? So that there will be a normal relationship between the maxilla and mandible? But what constitutes the norm? Must we reposition the head of the condyle in its most retrusive position in the mandibular fossa? Or by taking certain facial measurements and opening the bite to conform to these measurements will we be able to accomplish our end?

There is only one correct bite for each person.[4] All the measurements, statistics, and rules which have been assembled with the object of standardizing the length of the bite are dangerous because in each person the muscles of mastication bear a relation to the other parts of the head which is not duplicated in any other person. For this reason, no amount of analysis of the bite or correlation of data can give us a hard and fast rule for all patients. Statistics cannot be used to determine the ideal bite for all persons. It seems that many practitioners in making a restoration try by some mechanical means to improve the bite without giving due consideration to the effect that the change will have on all correlated tissues.

These have also been controversial problems which have plagued dentists, but they have, in most cases, been unable to solve this pertinent problem.

The malposition of the temporomandibular joint has been mentioned as a cause of obstructive deafness and tinnitus.[5] I do not believe that the temporomandibular joint has anything to do with obstructive deafness and tinnitus, and I do not believe that any of the various and odd articulators that we employ are in themselves too important. Loss of the posterior teeth or of all the teeth usually brings about a change in the proper relationship between the maxilla and mandible but I believe that the proper relationship between the maxilla and mandible is frequently maintained in the edentulous mouth. This proper relationship is established in infants before any teeth erupt, and I believe that we have all seen cases of a proper relationship of the jaws in patients after the teeth have been lost. It is the proper relation-

3. Costen, J. B.: Syndrome of Ear and Sinus Symptoms Dependent upon Disturbed Function of Temporomandibular Joint, Ann. Otol. Rhin. & Laryng. **43**:1 (March) 1934.

4. Mershon, H. F.: Bite Opening Dangers, J. Am. Dent. A. **26**:1972 (Dec.) 1939.

5. Bleicker, R. F.: Ear Disturbance of Temporomandibular Origin, J. Am. Dent. A. **25**:1390 (Sept.) 1938.

ship of the musculature that determines the position of the mandible, and it is the disturbance of this proper relationship which can affect the mechanism of the middle ear. In the literature and in the standard textbooks of anatomy a great deal of material about the temporomandibular joint will be found. With some of these statements we do not concur. In the literature when a case is reported of obstructive deafness and tinnitus caused by pathological conditions of the temporomandibular joint, it will be found that many authors mention perforated menisci and eroded tympanic plates. These conditions have been advanced as a possible cause of deafness.

In the anatomical laboratory at Temple University Dental School over a period of more than 20 years I have had the opportunity to dissect and examine a great many temporomandibular joints in every age group and in mouths of all descriptions, ranging from those with the full complement of teeth to those which are edentulous. I have never observed a perforated disc or an eroded tympanic plate, notwithstanding that some of the dissections done by students were not of the

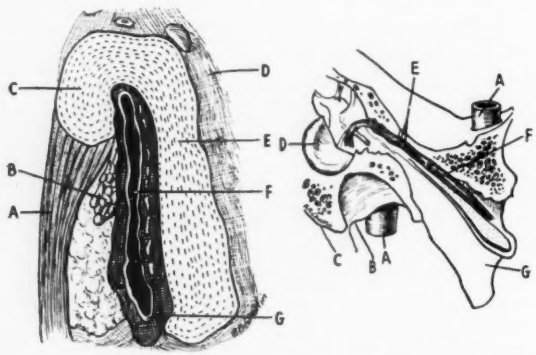

Fig. 1.—On the left is a transverse section through the middle of the cartilaginous portion of the auditory tube. *A*, indicates the tensor palati muscle, *B*, the mucus glands, *C*, the lateral cartilaginous lamina, *D*, the connective tissue, *E*, the medial cartilaginous lamina, *F*, the lumen of the auditory tube, and *G*, the membranous wall of the auditory tube. On the right is the right auditory tube opened lengthwise. *A*, indicates the internal carotid artery, *B*, the jugular fossa, *C*, the styloid process, *D*, the tympanic membrane, *E*, the tensor tympani muscle, *F*, the tensor palati muscle, and *G*, the pharyngeal opening of the tube.

cleanest type. The meniscus, or, as the textbooks describe it, the interarticular fibrocartilage, is not a pure fibrocartilage but possibly contains a certain amount of connective tissue, and there is every evidence that this connective tissue is capable of repair. Robinson [6] has found upon histological examination of the temporomandibular joint that the tissues found in this joint are not of the type found in stress-bearing joints. In the temporomandibular joint there is an absence of cancellous bone. Whenever a joint receives heavy stress as, for example, the hip joint or the shoulder joint, the bone is cancellous.

These facts, I believe, are pertinent in calling attention to the fact that the temporomandibular joint is so constructed that it was never meant to bear heavy stress.

6. Robinson, M.: The Temporomandibular Joint: Theory of Reflex Controlled Nonlever Action of the Mandible, J. Am. Dent. A. **33**:1260 (Oct.) 1946.

It is, therefore, obvious that significant stress is not transmitted upward through the condyle. In view of these findings, my associates and I cannot see how the temporomandibular joint plays any part in obstructive deafness and tinnitus.

Perlman [7] and other investigators have felt that there may be some relationship between the patency of the Eustachian tube and the musculature of the mandible. The tube, as you recall, goes from the nasopharynx to the middle ear. It is two-thirds cartilage and one-third bone, the opening of the cartilaginous portion in the nasopharynx being normally closed and opening only during the act of swallowing or yawning. The tube is for the transmission of air to the middle ear, thus equalizing the air pressure on either side of the drum membrane. The muscle which opens the tube is the tensor palati. There can be many factors involved in the disturbance of tubular function which could cause tinnitus and deafness: hypertrophy of tissue, new growths, and inflammation to mention a few of the pathological processes. This led to a study of the musculature involving these closely interrelated parts.

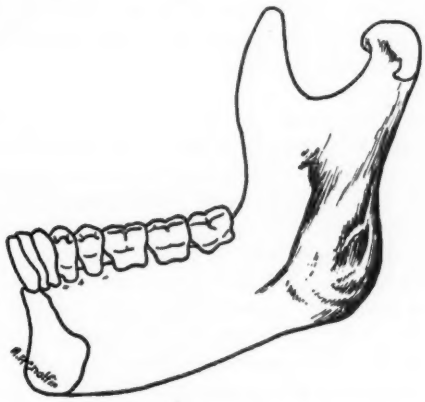

Fig. 2.—Internal surface of the mandible showing attachment (insertion) of the internal pterygoid muscle.

In the embryo, the mouth cavity [8] is not distinctly separated from the pharynx, the Eustachian tube, and the middle ear. The nasopharynx, including the apertures of the auditory tubes, becomes distinct along with the nasal cavity when the palate is formed. The middle ear,[9] the Eustachian tube, the pharynx, and the mouth are lined with mucous membrane, a fact directly related to the genetic or developmental relations of the parts, since the middle ear may be looked upon as a partially separated portion of the pharynx and the mouth. In the embryo is also found the pterygoid mass, which begins to split as the embryo proceeds in its development. This split finally evolves itself into three separate and distinct muscles. The main

7. Perlman, H. B.: Eustachian Tube: Abnormal Patency and Abnormal Physiologic State, Arch. Otolaryng. **30**:212 (Aug.) 1939.

8. Morris, H.: Morris' Human Anatomy: A Complete Systematic Treatise, Ed. 10, Philadelphia, The Blakiston Company, 1942.

9. Heisler, J.: Practical Anatomy: A Guide to the Dissection of the Human Body, Philadelphia, J. B. Lippincott Company, 1912.

bulk of the pterygoid mass becomes the largest muscle of the group, namely, the internal pterygoid muscle, whose function is to protrude the mandible and give it lateral motion. The second muscle given off from the pterygoid mass is the smaller and less potent tensor palati. The function of this muscle is to tense the soft palate and to open the Eustachian tube. The smallest and least potent of the three muscles from the pterygoid mass is the tensor tympani muscle. This muscle, penniform in shape and 2 cm. in length, attaches itself to the manubrium of the malleus, which lies against the tympanic, or ear drum, membrane. Its function is to tense the tympanic membrane. These three muscles interdigitate. The fibers of the internal pterygoid muscle blend with the fibers of the tensor palati,[10] and the fibers of the tensor palati muscle blend with the fibers of the tensor tympani.[11] Further evidence of the close interrelationship of these three muscles manifests itself in their nerve supply.

The internal pterygoid muscle is supplied by the large internal pterygoid nerve, which is a branch of the mandibular division of the trigeminal. The nerve supply to the tensor palati and the tensor tympani muscles is small fibers given off from the internal pterygoid nerve. This neuromuscular relationship is a perfect synchronization for the carrying out of muscular function. Here then are three muscles, all having the same embryological origin, all having the same nerve supply, yet each having a different function.

When we examine the behavior of muscles, we find that in the living muscles are never inactive. They are always in a state of partial contraction or, to put it another way, partial relaxation. This state we refer to as the tone of a muscle. In any muscular action there are numerous other muscles at work, whose action, though secondary, is designed to help the principle movement. This group of muscles is called a synergist. Muscles do not work by themselves. They work in groups. Thus one group of muscles opens the mouth, and another group closes the mouth. We must bear in mind that the larger the muscle [12]—that is, the greater the fleshy nature of the muscle—the greater is its stability and strength and the greater is its domination over that group of muscles with which it functions.

Accepting these anatomical and physiological facts, I should again like to call attention to the largest muscle of this group, the internal pterygoid. It would seem evident that because of its neuromuscular relationship any deviation from the norm of the internal pterygoid muscle would immediately cause a deviation from the norm of both the tensor palati and the tensor tympani muscles. This deviation from the norm of the interval pterygoid muscle can take place at the completion of growth—at about the 25th year of life. After growth is completed, changes continue to take place. This process is not perceptible in the beginning, but it speeds up as senescence approaches. Thus in the mouth we begin to have a wearing down of the molars, that is, a loss of vertical dimension. The loss of tone of the internal pterygoid muscle seems to run concurrently with this wearing down of the molars and with the symptoms of both tinnitus and loss of hearing acuity. When there is a change in

10. Cunningham, D. J.: Cunningham's Manual of Practical Anatomy, Vol. 3, Head and Neck: Brain, ed. 10, London, Oxford University Press, 1940.

11. Wolff, Rüdinger, von Tröltsch, and Mayer, cited by Graves, G. O., and Edwards, L. F.: The Eustachian Tube: A Review of Its Descriptive, Microscopic, Topographic and Clinical Anatomy, Arch. Otolaryng. **39**:359 (May) 1944.

12. Mackenzie, W. C.: The Action of Muscles, Including Muscle Rest and Muscle Reeducation, New York, Paul B. Hoeber, 1918.

tone of the internal pterygoid muscle, there is a change in tone of the tensor palati muscle. Thus there is an interference with the proper opening of the tube. This interferes with the proper aeration of the middle ear and can be a decided factor in tinnitus and deafness.

Whenever there is any change in the tone of the tensor palati muscle, there is a change in the tone of the tensor tympani muscle (either contracted too much or relaxed too much) and there immediately follows a change in auditory acuity. The diagnosis, of course, is one which the otologist must make. If this internal pterygoid muscle could be restored to its normal anatomical position, I feel that the tensor palati and tensor tympani muscles would also resume their normal anatomical positions. However, our problems were just how to reposition the jaw so that the internal pterygoid muscle might resume its normal position and how we would know when the internal pterygoid muscle was in its normal position. We realized that the routine prosthetic method of opening the bite by means of measurements was at best unable to cope with this problem. In the final analysis we are trying to restore the delicate fibers of the tensor tympani muscle to their normal tone.

Through the courtesy of the staff and the research department (particularly James A. De Pew, Jr., Mrs. Sonia Jarvis, and Miss Helen Harvie, the audiologist who works with me) of the New York Eye and Ear Infirmary, who placed their facilities at our disposal, we began our clinical studies. We are taking patients with a diagnosis of low tone deafness or tinnitus or both. The patient is placed in a sound- and damp-proof room and a hearing test is made with a speech-testing machine. This machine, a variation of the audiometer, is more useful for our purposes, in that we are using only those tones that come within the normal speaking range. The machine controls both the pitch and the loudness of the words. The results are then recorded on a chart, and the degree of hearing loss is ascertained in decibels. The decibel is a unit for the smallest change of sound intensity that can be heard.

Impressions are taken, and from the models bite blocks are made using a base plate and soft yellow wax. Each time the mandible is repositioned to what we think might be the norm for that person, another speech test is made and the record compared with the previous reading. We continue this repositioning process with a follow-up each time with a speech-recording test. As soon as there is an improvement of 10 db. or more, we construct a set of acrylic splints. The splints are worn for a period of three months. During this period tests are made at frequent intervals, that is, once a week, to see whether the decibel reading shows any further change. In each case the decibel reading has shown an increase in auditory acuity of at least 15 db. from the time the initial reading was made. Our final prostheses are constructed once the 15 db. change has been attained, and, of course, this is a substantial improvement in auditory acuity.

At the moment our work has not carried us far enough to enable us to say that the hearing loss will be still further decreased with the final prosthesis, but there is growing evidence that as the patient wears the appliances there is still greater improvement in auditory acuity. Most of the patients with obstructive deafness whom my associates and I have treated have also had tinnitus. While we have not

been able completely to eradicate these head noises, their intensity has been decreased, and here, too, there is growing evidence that the tinnitus may eventually disappear.

In summary, I should like to emphasize again that I do not believe that the temporomandibular joint plays any part in obstructive deafness and tinnitus. I believe that the genetic relationship of the musculature of the mandible, the auditory tube, and the middle ear are the causative factors in obstructive deafness and tinnitus. The promiscuous opening of the bite in patients with such conditions is a dangerous procedure unless it is done with definite biological controls.

The sciences of anatomy, physiology, and pathology coupled with clinical experience are the bases for a clear understanding of proper repositioning of the mandible.

The audiometric readings should be carried out under conditions of absolute scientific control, namely in a sound- and damp-proof room.

Finally, this type of service to be successful can be accomplished only by the closest cooperation between the dentist and the otologist.

33 West 42d St.

METASTATIC MALIGNANT MELANOMA OF THE LARYNX

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AND
JOHN S. ODESS, M.D.
BIRMINGHAM, ALA.

MANY standard textbooks of diseases of the ear, nose, and throat make the statement that malignant melanomas occur in the larynx. However, in a rather thorough search of the pertinent literature in English covering both primary and metastatic tumors of the larynx we found only one case of melanoepithelioma, reported by Havens and Parkhill.[1] We quote their findings in this particular case:

A man of 48 years came to the clinic complaining of a sense of irritation in the throat of one year's duration. There was a malignant-appearing, dark brown mass in the right hypopharynx, arising from the right arytenoid cartilage. Microscopic examination of tissue from the mass confirmed the clinical diagnosis of melanoepithelioma.

Because there was evidence of widespread metastasis, treatment was considered to be futile, and none was given. We have no information as to the subsequent course of events.

Melanoepithelioma (formerly classified by most pathologists as melanosarcoma) is exceedingly difficult to control, regardless of the site of its appearance. This is because of its marked tendency to give rise to early and widespread metastasis.

The treatment of melanoepithelioma of the larynx need not differ from that of any other type of active malignant lesion except that if one encounters a small lesion the appearance of which definitely suggests this diagnosis, a procedure should be selected which will permit of wide removal of the lesion and thorough cauterization of the wound at the same time. Biopsy of such a lesion, which possibly has not yet given rise to metastasis, is, we believe, contraindicated. Postoperative irradiation, both of the site of the local lesion and of the regional lymph nodes, is advisable.

Although melanoepithelioma, or "malignant melanoma," does not commonly arise in mucous membranes, nevertheless it has been reported in various parts of the alimentary canal, from palate to rectum, as well as in the nares, the pharynx and the larynx. Microscopic examination of the single tumor diagnosed as melanoepithelioma in this study revealed strands and alveolar masses of moderately large polyhedral cells with palely eosinophilic granular cytoplasm, round or polygonal basophilic nuclei and usually small nucleoli. Many of the tumor cells, especially near the periphery of the alveolar masses, contained fine granules of melanin in the cytoplasm. Moderately large, irregular blood spaces, intimately associated with the tumor cells, were fairly frequent.

REPORT OF A CASE

Mrs. P. C. C., white, aged 63, was first seen by us May 24, 1949. She stated that she had been hoarse for the previous eight months. She had been seen elsewhere by an otolaryngologist who told her she had "paralysis of a vocal cord." Our original mirror examination of the larynx

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1. Havens, F. Z., and Parkhill, E. M.: Tumors of the Larynx Other Than Squamous Cell Epithelioma, Arch. Otolaryng. **34**:1113-1122 (Dec.) 1941.

revealed a rounded, smooth, dark-colored tumor involving the entire right vocal cord causing obstruction of approximately 75% of the laryngeal lumen. The patient was extremely hoarse and moderately dyspnoeic.

The patient stated that three years prior to our examination a large, rounded, hard, nontender mass "the size of a hen's egg" had appeared in the subcutaneous tissue on the posterior aspect of the right shoulder. This original tumor was removed by her general surgeon in November, 1947, and was reported to be a malignant melanoma. During the interval from the removal of the original tumor until she was seen by us, 63 different tumors had appeared in the subcutaneous tissues of her body at varying sites. Several operations had been performed in the interim and as many as 13 tumors removed at one time, all of which proved to be "malignant melanoma" or "melanosarcoma."

During the month of June, 1949, she became progressively dyspnoeic, and she and her relatives were told that she would have to have a tracheotomy or a laryngofissure. She was greatly opposed to a tracheotomy; therefore a laryngofissure was performed July 16. The entire

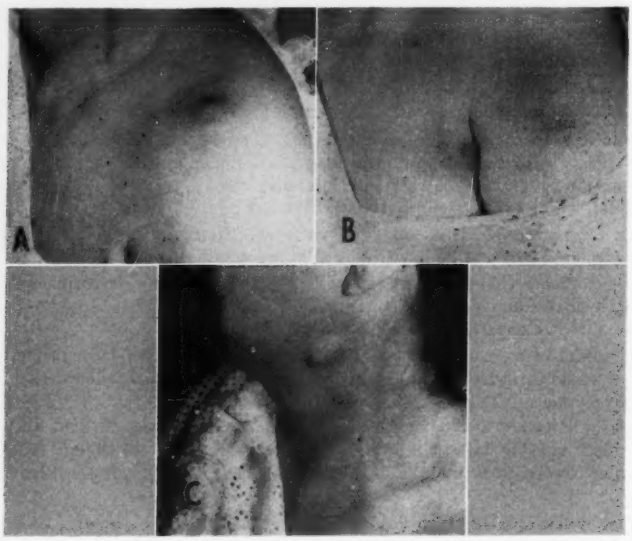

Fig. 1.—*A*, firm, discrete, and nontender metastatic melanoma on left shoulder. *B*, metastatic melanoma in left axilla. C, metastatic melanoma of left cervical region.

right true and false cords were removed. It appeared, on gross examination, that the entire tumor had been removed. Her postoperative convalescence was entirely uneventful.

She experienced no laryngeal difficulty until March, 1950, when she had a rather severe upper respiratory infection complicated by purulent sinusitis and laryngotracheobronchitis. This infection persisted for 10 days despite the use of antibiotics. When the infection subsided a definite swelling and fullness in the right posterior half of the larynx remained. This swelling increased rapidly, and a tracheotomy had to be performed March 14.

A roentgenologist was consulted who advised a course of x-ray therapy directed toward the right side of the larynx, although he stated definitely that the treatment might be of questionable value. X-ray therapy was begun March 17 and completed April 4. Very little change in the size of the swelling in the right side of the larynx could be noted during the following six weeks. During October increasing difficulty in swallowing developed and the patient had persistent bouts of coughing which were extremely distressing to both the patient and her relatives.

October 31 direct laryngoscopy and esophagoscopy revealed involvement of the tissue between the esophageal orifice and the posterior aspect of the larynx. After consultation with her general

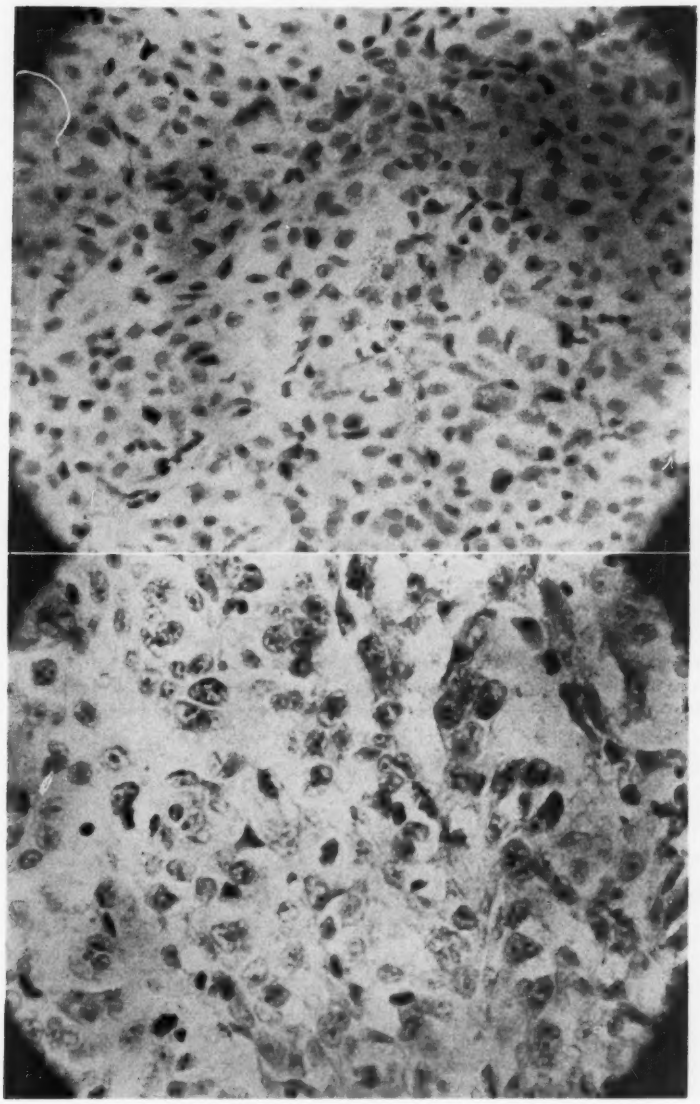

Fig. 2.—Low and high power microscopic views, respectively, of tissue from right vocal cord taken June 14, 1949. The microscopic description stated, "Section through the specimen submitted shows the margin of the vocal cord covered by a more or less transitional type of epithelium. This gradually shades off into masses of hyperchromic neoplastic epithelial cells showing some variation in nuclear size, moderately large nuclei, and usually a clear cytoplasm. These cells are arranged in peculiar clusters and seem in general to be of a more transitional type. The cells are tightly packed and show moderate numbers of mitotic figures." The diagnosis was metastatic melanoma of the right vocal cord.

surgeon, we performed a total laryngectomy and removal of the involved portion of the upper end of the esophagus on November 1. Convalescence was uneventful, the patient has not had further difficulty in swallowing, and the bouts of coughing have been entirely relieved.

In February, 1950; May, 1950; October, 1950, and January, 1951, Dr. John Carmichael, of Birmingham, Ala., removed numerous subcutaneous tumors from the shoulders, thighs and back of this patient. These tumors had all arisen on pressure areas and caused the patient great discomfort when she lay on an involved area.

Fig. 3.—Multiple large lesions over back, shoulder, and arm, with scars showing sites of tumors removed previously. This picture was taken two years after the original lesion was found in the larynx. Excerpts from the microscopic description of these tumors of the skin mention "crowded hyperchromic large tumor cells showing prominent nuclei of vesicular type in which there are large owl's-eye nucleoli," "in this nodule some of the tumor cells show large mitotic giant forms," and "In one of the nodules there is some brownish pigment within tumor cells."

We considered this particular patient to be so unusual and interesting that a report of the case was indicated. The patient is ambulatory and in apparent good health at present, except for the presence of numerous subcutaneous nodules on various parts of the body.

1023 S. 20th St. (5).

Jefferson-Hillman Hosp. (3)

PATULOUS EUSTACHIAN TUBE

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THE CONDITION of patulous Eustachian tube, while not very common, is much more prevalent than is usually supposed. It is, in all probability, frequently overlooked and has seldom been discussed. In looking through a large number of the standard textbooks on otolaryngology one can find very few that even mention it. However, Bezold and Ballenger give a very good discussion of the condition and outline a treatment for it. Although there are hundreds of papers written on the obstructed Eustachian tube and its various forms of treatment, a survey of the literature back to 1929 reveals only four articles on the Eustachian tube that is patulous.

As a rule patients with this condition are far more disturbed by their symptoms than are those with obstructed Eustachian tubes. They may be extremely nervous and may give one a strong impression of psychoneurosis at first. The symptoms are very characteristic but are often misleading because of the terminology used. Patients speak of the ear "stopping up" when they yawn or swallow. They say they can "open the ear again" by taking short, quick inspirations through the nose. One also may be misled by the temporary relief that is sometimes obtained by catheterization and inflation of the Eustachian tube.

SYMPTOMS

The symptoms are mainly on the basis of two phenomena which are both directly due to the patulous Eustachian tube.

1. There is a roaring in the ears synchronous with the patient's own breathing. This can often be heard by the examining physician through the diagnostic tube. It can be stopped by the patient holding his breath or breathing exclusively through the mouth. Some patients do the latter to such an extent that they are thought to have complete nasal obstruction. One such patient was asked why she did not breathe through her nose, after examination had revealed a free airway through the nose and nasopharynx. Her answer was that when she did breathe through her nose "it went ooo-ooo-ooo!" This intrinsic sound may interfere with the patient's hearing for external sounds, especially in the range around 500 db., but usually the audiometric curve is normal.

2. There is marked autophony. The patient's own voice sounds very loud and harsh to him. This may disturb him to the point where he tends to avoid talking to others.

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The patient obtains relief by a forceful, sharp, and short inspiration through the nose. This is often more effective if he holds the nostril while making the inspiratory effort—a sort of Valsalva maneuver in reverse. Lying down affords relief from his symptoms. This relief usually persists for some time after arising.

The symptoms are made worse by exercise. The resistance of the Eustachian tube to inflation actually decreases after exercise. Added to this, the exercise makes the patient breathe harder and faster, and this in turn magnifies the sounds in his own ears. One patient said he could not do any work around the house or garden because of this. If he did try, he would soon have to stop and lie down.

The examination may show nothing significant except for the sound of air passing through the open Eustachian tube on inflation. The audiogram may be normal. Frequently the examiner can hear the sound of the patient's breathing when his ear is connected with that of the patient by the diagnostic tube. A number of instances have been reported in which the ear drum membrane was observed to move with each inspiration. In these cases the membrane or portions of it was usually noted to be atrophic. None of our patients showed this phenomenon.

HISTORY

Perlman [1] stated that Toynbee [2] was the first to describe the Eustachian tube as being normally closed and open only during the act of swallowing. Politzer agreed with this, as did Jago [3] and Hinton,[4] whereas most of the German authors of that time disagreed. Perlman [5] subsequently proved this to be true by some very ingenious observations on human beings.

Rumbold [6] felt that the condition of abnormally patent Eustachian tube was not nearly as rare as Jago and Hinton had intimated. After the turn of the 20th century, the subject seemed to be forgotten until Zöllner,[7] Shambaugh,[8] and Perlman again described the same condition.

Bezold and Siebenmann [9] described a patient with patulous Eustachian tubes and stated that tympanophonia, both on breathing and talking, a trembling sensation

1. Perlman, H. B.: The Eustachian Tube: Abnormal Patency and Normal Physiologic State, Arch. Otolaryng. **30**:212-238 (Aug.) 1939.

2. Toynbee, J.: On the Muscles Which Open the Eustachian Tube, Proc. Roy. Soc., London **6**:286, 1853.

3. Jago, J.: Functions of the Tympanum, Brit. & For. M.-Chir. Rev. **45**:229, 1870.

4. Hinton, J., supplement to Toynbee, J.: The Diseases of the Ear: Their Nature, Diagnosis and Treatment, Ed. 2, London, H. K. Lewis, 1868, p. 447.

5. Perlman, H. B.: Mouth of the Eustachian Tube: Action During Swallowing and Phonation, A. M. A. Arch. Otolaryng. **53**:353-370 (April) 1951; Observations on the Eustachian Tube, ibid. **53**:370-386 (April) 1951.

6. Rumbold, T. E.: The Function of the Eustachian Tube, St. Louis, Southwestern Book and Publishing Company, 1873.

7. Zöllner, F.: Widerstandsmessungen an der Ohrtrompete zur Prüfung ihrer Wegsamkeit. Eine neues Verfahren und bisherige Ergebnisse an Ohrgesunden und -kranken, Arch. Ohren-, Nasen-u. Kehlkopfh. **140**:137-154, 1935.

8. Shambaugh, G. E., Jr.: Continuously Open Eustachian Tube, Arch. Otolaryng. **27**:420-425 (April) 1938.

9. Bezold, F., and Siebenmann, F.: Textbook of Otology for Physicians and Students, in Thirty-Two Lectures, translated by J. Holinger, Chicago, E. H. Colegrove Co., 1908, pp. 154-155.

of the tympanic membrane, and relatively normal auditory acuity were among the predominant symptoms. One of the authors was capable of keeping his own Eustachian tubes open and was thus able to check his own symptoms with those of the patient.

Jago [3] observed two patients with similar symptoms and observed himself for a period of 14 years, noting the same symptoms.

Voltolini [10] noted a few cases in which the tympanic membrane moved with respiration.

Buck [11] described two cases in which there was a cicatrix on the tympanic membrane. He noted movement of the cicatrix on respiration, whereas the remainder of the tympanic membrane was stationary.

Bezold [12] in a report of one case and Wagenhäuser [13] in a report of three cases described the symptoms that have been previously mentioned by other authors.

Perlman [1] was the first author to bring out clearly the diagnostic point of change of position and the manner in which it affects the symptoms. This was noted in all our patients. He credits Lucae and Hartmann with previously mentioning this. However, in his experience the change of position produced only a temporary closure of the Eustachian tube, whereas they found the closure to be much longer lasting. In our patients, leaning well forward and placing the head down between the knees or lying down produced the diagnostic change of symptoms.

Perlman also found that rapid barometric pressure change might be great enough to produce a change of symptoms, particularly in the case of a rapid weather change. He further found that nasal sounds, such as "N," "M," and "ng," are sufficient to open the Eustachian tube forcibly. One of his patients had such a widely patent Eustachian tube that nasal sounds were transmitted through an auscultation tube. He quotes Hartmann as saying that vowels, "E," "I," "O," and "U," decrease the pressure needed to open the Eustachian tube from 32 mg. of mercury to 12 mg. as tested by Valsalva's maneuver.

He also quoted Gyergyay as saying that fatigue of muscles around the torus, after many acts of swallowing, caused the Eustachian tube to remain open. He also found that the tube most regularly opens during swallowing in the early morning after awakening.

Perlman described an interesting method of his own device for checking the patency of the Eustachian tube. He used a glass bulb with a nasal suction tip which was attached to the rubber tubing of a mercury-type sphygmomanometer. This was held firmly in one nostril by the subject, and the other nostril was occluded with a finger. The examiner listened with an auscultating tube while watching the mercury gauge. The subject then performed a Valsalva maneuver. A low-pitched "lub" was heard as the Eustachian tube opened. This might be further checked by Politzer's method of watching for outward displacement of the tympanic membrane; however, this technique requires two examiners—one to watch the mercury gauge and another to watch the tympanic membrane. A minimal pressure of 20 mm. of mercury is

10. Voltolini, R.: Zwei eigentümliche Ohrenkrankheiten, Monatsschr. Ohrenh. **17**:1-6, 1883.

11. Buck, A. H.: Unnatural Patency of the Eustachian Tube, Am. J. Otol. **2**:203-205, 1880.

12. Bezold, F.: Gesammtbericht über die 1881-1883 incl. behandelten Ohrenkranken, Arch. Ohrenh. **21**:221-266, 1884.

13. Wagenhäuser: Bericht über die in der Poliklinik für Ohrenkranke zu Tübingen, vom 1. April 1883 bis 1. April 1884 beobachteten Krankheitsfälle, Arch. Ohrenh. **21**:267-275, 1884.

required for a normal Eustachian tube. Marked variation is noted in the abnormally patent Eustachian tube, the pressure varying from 2 to 12 mm. of mercury. In the prone position the amount of pressure required to open the Eustachian tube is inevitably raised, even in the normal ear. The amount of this change varies from 2 to 40 mm. of mercury. Perlman also found that exercise reduced the amount of pressure required to open the tube even as much as one-half. This change may be produced by a simple measure such as jumping up and down 10 times and lasted approximately five minutes.

PATHOLOGY

Bezold and Siebenmann [9] noted that the condition developed in generalized emaciation such as that seen in the last stages of phthisis, senile marasmus, or other serious diseases. Because of this, Bezold [14] felt that atrophy of the fat layer of Rudinger around the cartilaginous tube was the principal cause of patulous Eustachian tube. He felt that the atrophy caused the external membranous wall to become detached from the inner cartilaginous wall and produce a gaping tubal aperture.

Shambaugh [8] noted that the contraction of scar tissue seven weeks after an adenoidectomy caused an overly patent Eustachian tube in one of his patients. In another symptoms developed following irradiation for carcinoma of the nasopharynx. Still another showed atrophy of the mucosa secondary to emaciation due to carcinoma of the ovary.

Pitman [15] felt that adhesive bands running from the posterior border of the Eustachian tube, bridged across the fossa of Rosenmüller, and attached to some portion of the nasopharynx would retract the posterior wall of the Eustachian tube backward and cause it to be kept open. He stated that in the majority of these cases there was no history of previous nasopharyngeal operations or preexisting inflammatory conditions. This is quite in contradiction to the feeling of the aforementioned authors. He also mentioned paralysis of the levator palati muscle as another possible cause for the condition, further stating that it could be quickly ruled out as a possible cause by normal function of the soft palate. Finally, he discussed hypertrophied tonsils as a most likely cause. He felt that a high-domed hypertrophied tonsil, on account of upward pressure, tended to elevate the levator palati muscle, in turn pushing the alar cartilage backward, upward, and inward, thus causing the pharyngeal orifice of the tube to remain open. He demonstrated this as a cause by removing the tonsils and noting that the pharyngeal orifice again became slit-like. Then, while observing with a nasopharyngoscope, he placed a sponge in the tonsil fossa and pushed upward. The pharyngeal orifice could then be seen to resume its triangular shape.

Further, Pitman gave an excellent review of the structure and movement of the pharyngeal portion of the Eustachian tube. He stated that the pathologically patent Eustachian tube could be recognized by use of the nasopharyngoscope. In the normal tube, the opening was only a slit. This slit opened in a triangular manner when the patient said "Ka." In the pathologically patent Eustachian tube, the triangular opening was found to be present at all times. Halsted [16] felt that recurrent infection

14. Bezold, F.: Progress of Otology, Arch. Otol. **14**:216, 1885.

15. Pitman, L. K.: The Open Eustachian Tube, Arch. Otolaryng. **9**:494-500 (May) 1929.

16. Halsted, T. H.: Pathology and Surgery of the Eustachian Tube, with Special Reference to the Value of Closing It, Arch. Otolaryng. **4**:189-195 (Sept.) 1926.

of the adenoids and lymphoid tissue around the torus, chronic sinusitis producing purulent postnasal drip over the orifice, and trauma such as in an adenoidectomy might cause a patulous Eustachian tube. He also mentioned carcinoma of the fossa of Rosenmüller, tuberculosis of the Eustachian tube, and syphilitic ulceration or chancre from infected instruments as possible causes.

In several of Perlman's patients, the symptoms followed retrogasserian neurectomy. He explained this on the basis of partial or complete paralysis of the tensor veli palatini muscle. He quoted Politzer's experiment on stimulation of the intracranial portion of the trigeminal nerve causing an increase in the orifice of the Eustachian tube.

TABLE 1.—*Factors Affecting the Patency of the Eustachian Tube**

Factors Causing Closure of the Patent Eustachian Tube	Factors Causing the Pathologically Patent Tube to Open and Remain Open
Inspiratory effort with mouth and nose closed (Jago)	Summer and autumn (Jano)
Hearty meal	Nervousness
Reclining posture	Increase in activity of the heart
Bending head forward on chest (Lucae)	Fatigue, as from sleepless night or strenuous activity
Catheterization and inflation of the tube	Erect posture
Application of silver nitrate to mouth of tube (Rumbold)	Loss of weight
Insufflation of boric and salicylic acid powder (4 parts to 1)	Hot weather
Coming into warm room on cold day	Being out in cold day
Strong pressure on tragus	Cold drink
Constant electric current with canal filled with saline solution	Spray of 0.25 per cent solution of neosynephrin hydrochloride in nose
In presence of perforated drum (Rumbold)	Spray of 10 per cent solution of cocaine hydrochloride in nose
(*a*) Drop of water in ear	Deep respiration
(*b*) Pledget of cotton soaked with glycerin water	Pronouncing nasally produced sounds, such as "M," "N," "ng"
Bougie in Eustachian tube	Coughing, belching, sneezing, blowing the nose
Filling external canal with saline solution	Dysfunction of tubal muscles after injury to motor division of fifth nerve in retrogasserian neurectomy
Gargling	Stooping, yawning
Speaking	Loss of tissue of the tube, as in syphilis or carcinoma
Inflation of Eustachian tube with zinc sulfate solution	Beginning or "dry stage" of acute infection of upper part of respiratory tract (Rumbold)
Infection of paraffin about the tube (Zöllner)	

* Table 1 is reproduced with the consent of Dr. H. B. Perlman.[1]

TREATMENT

The treatment of the condition has varied widely from time to time. McAuliffe [17] used nitric acid and phenol applied to the Eustachian tube orifice. Zöllner, as previously mentioned, infiltrated paraffin around the Eustachian tube orifice. Halsted felt that electrocautery to the Eustachian tube orifice might be beneficial.

Bezold and Siebenmann first advocated the insufflation of a mixture of salicylic acid powder and boric acid powder—in the proportions of 1:4—through a Eustachian tube catheter. This same treatment was used by Perlman and Shambaugh. We followed the same plan in our own patients.

REPORT OF CASES

CASE 1.—A 31-year-old man was seen in 1946 bitterly complaining of autophony and the sound of his own breathing in his right ear. This was extremely annoying to him. His symptoms

17. McAuliffe, G. B.: Dilatation and Stenosis of the Eustachian Tube, New York Eye & Ear Infirm. Rep. **6**:116-118, 1898.

were completely relieved when he lay down and for some time after he arose. He had sought relief for about 20 years without avail. Exercise aggravated his symptoms. Weather changes from cool to hot temperatures brought on the condition. He was free of ear complaints when he had a head cold. Forceful inspiration relieved him temporarily. His symptoms caused him a considerable amount of mental agitation.

Examination revealed the septum to be straight. The sinuses were clear on transillumination. The tonsils were cleanly removed. There was an adhesion in the right fossa of Rosenmüller extending down to the torus tubaris. The right drum membrane was atrophic in its posterior half and presented a small dry perforation with ragged edges in this area. The audiogram was essentially normal. The sound of the patient's breathing was very loud when one listened through the diagnostic tube placed in the right external auditory canal. Inflation of the right Eustachian tube showed it to be widely open and gave him momentary, partial relief. Insufflation of a mixture of salicylic acid powder and boric acid powder in the proportions of 1:4 resulted in instant and dramatic relief of his symptoms. The sound of his breathing in the diagnostic tube ceased immediately. The treatments with the powder have had to be repeated many times at increasing time intervals, but on each occasion he has obtained complete relief. The adhesion in the fossa of Rosenmüller was separated without any effect on his condition.

CASE 2.—On Jan. 21, 1947, a 56-year-old woman was examined for an increasing difficulty in hearing. This was accompanied by a sensation of fullness and a blowing tinnitus in her left ear. She denied having vertigo and previous ear infections.

Physical examination revealed slightly thickened tympanic membranes. Audiometric tests showed a mixed perceptive deafness of moderate degree. Inflation of the Eustachian tubes revealed the right to be slightly stuffy, whereas the left was wide open.

The patient returned to the office on April 28, this time saying that she could hear herself breathing in her left ear and that her voice seemed to reverberate in that ear. She used to be able to relieve her symptoms by forcibly inspiring through her nose. Lying down relieved these symptoms. Swallowing or yawning caused her left ear to seem to go dull. One treatment, as described above, gave her complete relief of symptoms.

CASE 3.—A 55-year-old man was examined on Feb. 18, 1947. He complained of a peculiar sensation in his ears. He said that they seemed to open up and close intermittently. When they were open, he could hear himself breathing.

Physical examination revealed both tympanic membranes to be within normal limits. Both Eustachian tubes were wide open. Insufflation of salicylic acid and boric acid powder 1:4 gave 50% relief of symptoms. The patient did not return for further treatment.

CASE 4.—A 69-year-old woman was examined on April 9, 1947, for roaring in her right ear. This had been present for one year. She said that she felt as if she had something in the ear. Previously she had had similar symptoms in her left ear, but these had spontaneously disappeared. She denied having hearing loss and vertigo. Her own voice sounded too loud in her right ear, and she could hear herself breathing in her right ear. Her symptoms were completely relieved when she lay down.

Physical examination showed the tympanic membranes to be relatively atrophic. Results of audiometric tests were within normal limits. The Eustachian tubes were wide open. The patient's breathing was distinctly heard through the diagnostic tube placed in the right ear. She was completely relieved of all symptoms by insufflation of salicylic acid-boric acid powder 1:4 through a catheter.

CASE 5.—A 76-year-old man complained on June 6, 1947, that he could not hear himself talk distinctly unless he was lying down or bending forward. These symptoms had been present for two months. They are not typical of the condition and have not been encountered in any other patient. He could, at all times, hear others speak very well. He denied having tinnitus and vertigo.

Physical examination showed him to have atrophic tympanic membranes. Both Eustachian tubes were wide open on inflation and on examination with a nasopharyngoscope. The patient's breathing could be heard through the diagnostic tube. Audiometric tests showed a minimal perceptive deafness bilaterally. Results of laboratory tests were negative. Insufflation as described in the other cases above listed produced complete relief of symptoms. This treatment was repeated six times at intervals of four to seven days.

CASE 6.—A 57-year-old woman was seen on July 9, 1948. She complained of a roaring in her left ear which had been present, intermittently, during the past three years. These symptoms had been constantly present during the past two weeks. When the patient held her breath, the roaring stopped, and it was replaced by a soft pulsating sound synchronous with the heart beat. When the noise was present, the hearing in the left ear was impaired. When the patient had a cold, the roaring was diminished or absent. Roaring was worse on damp days.

Physical examination showed the tympanic membranes to be normal. The Eustachian tubes were large and patulous. Audiometric examination showed a mixed perceptive deafness bilaterally. The medical department made a diagnosis of malnutrition. Treatment consisted of insufflation of salicylic acid-boric acid powder 1 : 4 into the Eustachian tube via catheter and afforded complete relief.

CASE 7.—A 53-year-old woman was seen on Oct. 20, 1948, because of a roaring sound in her left ear of one year's duration. She noticed this only when she breathed through her nose. When she would hold her breath or would lie down the sound would disappear. There was autophony in the left ear. There had been some recent mild pain in the left ear. She could not remember any drainage from the left ear but stated there had been an intermittent otorrhea on the right since an attack of scarlet fever at the age of 4 years.

Examination revealed a large dry central perforation in the right drum membrane. The left membrane was thickened and presented a small dry perforation in the anterosuperior quadrant. The audiogram showed conductive deafness on the right. The rest of the nose and throat examination showed nothing significant. The left Eustachian tube was found to be widely open on inflation. A mixture of salicylic acid powder and boric acid powder in the proportions 1 : 4 was insufflated through the Eustachian tube catheter. This gave the patient relief for about two days. She returned in one week, and the treatment was repeated.

CASE 8.—A 38-year-old woman was first examined May 12, 1949. She stated that she could hear herself breathing in her right ear only. This had occurred intermittently during the past month. She had had intermittent bouts of deafness and tinnitus along with this. She denied having had vertigo. She had never had otorrhea. Swallowing relieved her symptoms. Two years before, she had had similar complaints which cleared up spontaneously in about one month. She stated that she never had symptoms when she was lying down.

Physical examination revealed normal-appearing tympanic membranes. The Eustachian tube orifices were wide open. Audiometric tests showed a mild perceptive deafness on the left. Results of laboratory tests were within normal limits.

Treatment consisted of insufflation of the salicylic acid-boric acid powder 1 : 4 into the right Eustachian tube through a Eustachian tube catheter. This gave immediate relief of symptoms.

CASE 9.—A 45-year-old man had been under treatment off and on because of tubal catarrh. A few years before he was seen by us he had had secretory catarrh on the left which had been relieved by a series of inflations. From April until July, 1949, the right Eustachian tube had been partially obstructed and had cleared after inflations. On July 8, he complained of autophony and hearing his own breathing in the left ear for the first time. He stated that quick inspirations through the nose relieved the symptoms. On inflation the left Eustachian tube was found to be widely open. The salicylic acid-boric acid powder mixture was insufflated into the left Eustachian tube. He stated that this treatment gave him relief for about one day, but he did not return until August 6, when the treatment was repeated. He was treated again on August 27, September 17, and November 4. He was not seen again until March, 1951, when he had an acute upper respiratory infection with some inflammation of the left tympanum.

CASE 10.—A 21-year-old woman first came into the office on Dec. 6, 1949, saying, "I know that it sounds crazy, but I can hear myself breathing." She had had these symptoms intermittently for three years. She denied having tinnitus and vertigo but said that her auditory acuity was decreased owing to the extraneous sound of hearing herself breathing. She gained complete relief of symptoms on bending forward or lying down. She had previously been prescribed the following treatments: nose drops, neck exercises, and self-politerization. None of these had helped.

Physical examination, including audiometric tests, showed nothing significant aside from the condition of Eustachian tubes which were found to be wide open on examination with a nasopharyngoscope and on inflation.

This patient, too, was treated by insufflation of salicylic acid-boric acid powder 1:4. She gained immediate and complete relief. However, on December 20, she returned to the office saying that she was beginning to note a recurrence of symptoms. She was given the same treatment as before and had noted no recurrence as long as nine months afterward, when she came in for another complaint.

CASE 11.—A 60-year-old woman was referred to us on March 31, 1950, because of recurring attacks of vertigo lasting three to five days at intervals of four to six months. These attacks had been present over a period of six years. At times there was a sensation of rotation, but most of her discomfort was due to a loss of equilibrium on sudden motion. There had been some slight nausea. She had also experienced recurring attacks of roaring in her left ear which had not been associated with her dizziness. She had autophony in the left ear, and the sound of her breathing constantly annoyed her.

On examination, the ear drum membranes were found to be intact and dull. The nasal septum was deviated to the left posteriorly, causing some obstruction on this side. The tubal openings appeared somewhat oval when viewed through the nasopharyngoscope. The audiogram showed some bilateral perceptive loss for high tones. The left Eustachian tube was patulous on inflation. She was given thiamine hydrochloride, 10 mg. twice a day, and nicotinic acid (niacin®), 100 mg. three times a day, after meals. A pinch of the salicylic acid-boric acid powder was insufflated into the left Eustachian tube. She was next seen on May 2, 1951. She stated that she had been free of vertigo all summer, but it had now returned. The left Eustachian tube was again found patulous and was treated with the powder. She was told to resume her thiamine-nicotinic acid treatment.

CASE 12.—A 20-year-old woman came to the office on May 30, 1950, complaining of her ears "crackling." She had had trouble for four years and had been unable to find relief. She stated that swallowing and blowing her nose "opened the ears up" and brought on autophony and a noise like the wind blowing as she breathed. Holding her nose and sniffing in sharply gave her relief, as did lying down. She said that her ears gave her no trouble when she had a head cold.

Results of examination, including an audiogram, were normal. Both Eustachian tubes were found to be patulous on inflation. She was treated with the salicylic acid-boric acid powder. The patient obtained immediate relief. She was treated again two weeks later, then came in at weekly intervals for three treatments. After this she received four treatments at one- to three-month intervals. Her last treatment was six months before the present date.

RÉSUMÉ

A review of the literature on the subject has been presented.

Perlman's technique for measuring the pressure required to open the Eustachian tube has been reviewed.

The symptoms of patulous Eustachian tube are variable, as in other diseases, but usually include tympanophonia and autophony and are relieved when the person lies down or bends forward with the head well down between the knees. They are also relieved by forcible inspiration through the nose. The auditory acuity is affected very little by the condition.

The pathological basis for the condition is not always constant, and, in many cases, the etiological agent remains entirely undetermined.

Treatment advocated for the condition varies from one author to another, but salicylic acid and boric acid powders, 1:4, insufflated directly through a malleable sterling silver catheter appear to be the most successful.

A review of 12 case histories has been presented.

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FOREIGN BODIES IN THE AIR AND FOOD PASSAGES

Observations in One Hundred Eight Private Patients

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THE FIELD of bronchoesophagology has expanded so rapidly that the management of foreign bodies in the air and food passages no longer occupies the prominent position that it did in the earlier years of this specialty. To the average general physician and to the layman this is still the most spectacular and important of all endoscopic procedures. The removal of foreign bodies is still a challenge to every endoscopist because of the variety of objects swallowed or aspirated, the technical difficulties involved, and the complications which may occur. There is an abundance of literature on this subject, but the majority comes from large centers with established bronchoscopic clinics or departments. Until about 20 years ago the vast majority of all endoscopic procedures were performed in a few institutions. With the advancement of resident training in otolaryngology there are now physicians in all parts of this country practicing bronchoesophagology. Removal of foreign bodies constitutes a considerable part of the endoscopic procedures, and the endoscopist's success in handling such cases frequently serves as a criterion of his ability in all phases of this part of his specialty. The otolaryngologist in private practice, doing occasional bronchoscopic procedures, is not able to maintain the same endoscopic instrumentarium as a large institution. To such a physician the management of foreign bodies presents all the difficulties and complications usually encountered plus the problem of caring for his patients with limited facilities and untrained assistants.

This study is based on a survey of my private patients admitted to the hospital for endoscopic procedures during the period from 1943 to 1950. All were seen at the Houston Eye, Ear and Throat Hospital, a private institution without an organized clinic or department of bronchoesophagology. During this period there were 355 patients admitted for all types of endoscopic procedures. Of this number, 125 were admitted for removal of foreign bodies. This series includes reports of 108 cases, 95 of foreign bodies in the food passages and 13 of foreign bodies in the air passages. In 104, one or more foreign bodies, either exogenous or endogenous, were removed. Four cases are included in which the foreign body was not removed by endoscopy, but which are of interest because of difficulties presented or complications which occurred. In two, removal was attempted, but the foreign body passed into the stomach. In one the foreign body could not be removed endoscopically, and in another there was a congenital malformation of the lung instead of a bronchial foreign body. In 17 cases a foreign body was suspected from the history, and the physical and roentgenological examinations but was not found by endoscopy.

All the essential endoscopic instruments, as well as adequately equipped operating rooms and an experienced nursing staff, were always available. X-ray facilities, except for a biplane fluoroscope, were also available. A standardized technique, as advocated by Jackson and Jackson,[1] could not be followed, as there were no interns, residents, or trained assistants in the hospital. A Haslinger mechanical head rest was used for all adults, but head-holding was employed for children. The mechanical head rest was found to be satisfactory for all tracheobronchial work and for esophageal procedures, except in a few instances in which the cardiac portion had to be examined in heavy patients with thick necks. A number of these patients were seen as emergency cases at night or on holidays, and with the use of the Haslinger head rest the entire operating-room staff did not have to be called back to duty. A Roberts esophageal speculum was preferred for foreign bodies of the upper esophagus; however, this was not available when the patients of the first part of this series were treated. A short Jackson esophagoscope was used in adults, and in infants or children the child-size laryngoscope or anterior commissure scope was satisfactory for removing objects just below the cricopharyngeal orifice. Local anesthesia was used for all adults, but general anesthesia was employed for 25

TABLE 1.—*Age Incidence of Patients*

0-2 yr.	35
2-5 yr.	12
5-17 yr.	5
Adults	56
	108

children, 14 with esophageal foreign bodies and 11 with tracheobronchial foreign bodies. When it was felt that children were cooperative and could be handled, the procedures were performed without anesthesia; but if the child was crying, irritable, and restless, general anesthesia was employed. Observations from this series agree with those of Phelps [2] in that no complications have been seen that could be attributed to ether anesthesia. The length of hospitalization varied from a few hours to four weeks. During the first three years of this study the war caused a shortage of hospital beds. In a number of cases when removal was uncomplicated the patient was allowed to leave the hospital within a few hours after the procedure.

The ages in this series varied from 4 months to 86 years (Table 1). Of the patients, 56 were adults and 47 were under 5 years of age. All the tracheobronchial foreign bodies occurred in children 4 years of age or younger, the youngest being 5 months of age. Of the 95 esophageal foreign bodies, 56 were in adults and 39 in children.

This series does not include the variety of foreign bodies seen in a large bronchoscopic clinic or even in the general hospitals of this city, where a broncholith and

1. Jackson, C., and Jackson, C. L.: Bronchoscopy, Esophagoscopy and Gastroscopy, Ed. 3, Philadelphia, W. B. Saunders Company, 1934.

2. Phelps, K. A.: Foreign Bodies Lodged in the Air or Food Passages, Minnesota Med. **27**:27-31 (Jan.) 1944.

a coin lodged in the laryngeal ventricle have been reported.[3] Aspiration of stomach contents while the patient was under general anesthesia or intoxicated with alcohol accounts for a certain group of bronchial foreign bodies, but none of this type is included in this series. Numerous authors [4] have observed a relation of the type of foreign body to the age of the patient. A similar correlation is present in this series, with a smaller percentage of foreign bodies occurring in the age group from 5 years to adult life. Chicken bones accounted for the largest number of foreign bodies: 27, or 25% (Table 2). Coins were next, accounting for 21, or 19.5%. The third was meat, accounting for 12, or 11.1%. Fish bones and vegetal foreign bodies both accounted for nine, or 8.3%. Pins, large bones, and food each accounted for five, or 4.6%. All the chicken bones and meat occurred in adults, and all the coins and tracheobronchial foreign bodies occurred in children (Tables 3 and 4).

ESOPHAGEAL FOREIGN BODIES

Foreign bodies in the food passages comprised 95 of the 108 cases; 39, or 41.5%, occurred in children, and 56, or 58.95%, were in adults. Carelessness was responsible for the majority of the cases in children. Parents or nurses allowed objects such as pins, coins, and buttons to be within reach of infants or small children; and, even worse, at times these were given to them as toys. Children under 2 years of age instinctively put everything in their mouth, and those between 2 and 5 years will usually put objects in their mouth unless under careful observation. In this series most of the children swallowed the foreign body while unattended. There were four cases in which the accident occurred while children were being allowed to play with coins or buttons, and in two others the objects had been given them by older children. Excitement or panic on the part of the parents contributed to the incidence of foreign bodies. When an episode of choking or gagging is heard or observed by parents and a foreign body is suspected, they almost instinctively put a finger into the mouth and attempt to remove it. This often causes the object to become impacted in the hypopharynx, larynx, or esophagus. This history was given for eight children, three with coins, two with open safety pins, one with a marble, and two with tracheobronchial foreign bodies. In the age group between 5 and 17 years, accident or pathological condition of the esophagus was responsible for the five cases. Two fish bones and a whistle were swallowed accidentally, and the other two children had impacted food secondary to a cardiospasm. Foreign bodies in adults are almost invariably due to accident; however, some psychotic or insane patients swallow objects intentionally. In this group all were due to accident. Artificial dentures are probably the underlying cause of many of these accidents.

3. Barrett, J. H.: Broncholithiasis, Arch. Otolaryng. **44**:574-580 (Nov.) 1946. Withers, B. T.: Foreign Bodies of the Larynx with Report of an Unusual Case, Ann. Otol. Rhin. & Laryng. **58**:1085-1093 (Dec.) 1949.

4. Holinger, P. H.; Andrews, A. H., Jr., and Rigby, R. G.: Foreign Bodies in the Air and Food Passages, Eye, Ear, Nose & Throat Month. **22**:415-424 (Nov.) 1943. Jackson, C., and Jackson, C. L.: Diseases of the Air and Food Passages of Foreign Body Origin, Philadelphia, W. B. Saunders Company, 1936. Norris, C. M.: Foreign Bodies in the Air and Food Passages: A Series of 250 Cases, Ann. Otol. Rhin. & Laryng. **57**:1049-1071 (Dec.) 1948. Suehs, O. W.: Foreign Bodies in Air and Food Passages, Observations on a Series of 85 Cases, Texas J. Med. **46**:298-303 (May) 1950.

TABLE 2.—*Number of Patients with Each Type of Foreign Body*

Chicken bone	27
Coin	21
Meat	12
Fish bone	9
Nut, seed, and bean	9
Large bones	5
Pins	5
Other food material	5
Button	3
Glass	2
Metal whistle	2
Metal slug	1
Metal guard from notebook	1
Locket	1
Metal nut	1
Mucous plug	2
Marble	1
.22 Rifle shell	1
	108

TABLE 3.—*Incidence of Foreign Body in Relation to Age of Patients*

Type of Foreign Body	0-2 Yr.	2-5 Yr.	5-17 Yr.	Adults	Total
Chicken bone	0	0	0	27	27
Coin	18	3	0	0	21
Meat	0	0	0	12	12
Fish bone	0	0	2	7	9
Nut, seed, and bean	5	4	0	0	9
Large bones	1	0	0	4	5
Pins	3	1	0	1	5
Bolus of food	0	0	2	3	5
Buttons	3	0	0	0	3
Glass	0	0	0	2	2
Metal whistle	0	1	1	0	2
Metal slug	1	0	0	0	1
Metal guard from notebook	1	0	0	0	1
Locket	0	1	0	0	1
Metal nut	1	0	0	0	1
Mucous plug	2	0	0	0	2
Marble	0	1	0	0	1
.22 Rifle shell	0	1	0	0	1
					108

TABLE 4.—*Anatomic Location of Foreign Bodies*

Hypopharynx		4
Larynx		1
Trachea		3
Bronchi		9
Right	7	
Left	2	
Esophagus		91
Cervical	57	
Thoracic	21	
Cardiac	13	
Total		108

The hard palate is rendered insensitive by the dental plate, and the object swallowed is under the reflex action of the constrictor muscles before it is detected. Of the 56 adults, 41 wore some type of artificial denture. Another contributing cause is the commercial practice of chopping chicken rather than disjointing it. This custom, though timesaving, creates many slivers of bone that otherwise would not be present. In this series five patients swallowed a chicken bone while eating at the same restaurant.

The history of the swallowing of a foreign body is easily obtained for adults, but it is often missed for children. When the initial symptoms of gagging, choking, or coughing in children are not observed by the parents, the foreign body may not be suspected until obstructive symptoms occur. Children under 5 years of age can seldom describe their subjective symptoms well enough to make the history of value, and, in addition, there may be a symptomless stage. Often odynophagia, dysphagia, or overflow of secretions into the trachea is the first symptom noticed. Of the 39 foreign bodies in children, 10 had been present four days or more. Of this number, eight had been present from four to seven days, and two had been present for two weeks. One child was referred to a pediatrician because of projectile vomiting, and a roentgenogram of the chest revealed a large metal object (metal coat button) in the midesophagus about the level of the aortic arch. In adults, the swallowing of a foreign body is rarely missed. Usually they are aware of the accident and by the discomfort produced can often locate the level at which the foreign body is lodged. For none of the 56 adults was the history of the accident lacking. In many cases an object is swallowed which causes trauma in the hypopharynx or esophagus, and the symptoms produced are indistinguishable from those of a foreign body. During this study, 14 patients were seen in whom a foreign body was suspected from the history and results of physical and roentgen examination but was not found by esophagoscopy. Of this number, 13 were adults. In the same period 32 other patients were seen with a history of foreign bodies, but endoscopy was not advised because of the lack of significant physical examination and roentgen findings. All were kept under observation until the symptoms subsided. Twenty-three other patients were seen in whom the foreign body was located in the hypopharynx, oropharynx, or nasopharynx and could be removed by indirect procedures. Of this number, 21 had fish bones, one a chicken bone, and the other a straight pin.

The physical signs of an uncomplicated esophageal foreign body are inconstant. The subjective symptoms and the results of roentgen examination are the cardinal factors in the diagnosis. Phelps [2] states that once a foreign body has become lodged, the patient is rarely in an emergency condition. This is especially true of esophageal foreign bodies. In adults, tenderness over the point of lodgement, accumulation of saliva in the hypopharynx, or evidence of trauma were the only important objective physical signs noted. Children often held their head to one side or kept their neck stiffened. In the case of one child, a marble was large enough to press on the trachea and cause slight dyspnea. Complications usually caused signs of toxemia when perforation of the wall was present or pulmonary signs when obstruction caused overflow into the trachea. Roentgen study was made except in a few patients in whom the foreign body could be seen by mirror examination to be in the hypopharynx or in whom prolonged obstruction was a contraindication. The opaque

foreign bodies and large bones presented no difficulty. Roentgenograms were diagnostic in about three-fourths of the patients with chicken bones. The lateral view was usually diagnostic when other views were not. For patients with fish bones, roentgenograms were of little value, even after the swallowing of barium. The diagnosis of nonopaque foreign bodies, such as meat or food, was not aided by roentgen examination except when a barium study was made.

ENDOSCOPIC FINDINGS AND DIFFICULTIES IN ESOPHAGEAL FOREIGN BODIES

In this series, of the 95 foreign bodies in the food passages, 4 were in the hypopharynx and 91 in the esophagus. The foreign bodies removed by peroral endoscopy from the hypopharynx were a pin, a chicken bone, a fish bone, and a piece of glass (Table 5).

Of the 27 chicken bones, 1 was lodged in the hypopharynx, 20 in the cervical esophagus, 6 in the thoracic portion, and none in the cardiac portion. Flat triangular pieces accounted for about 60% of the bones. However, these were easier to remove than the spicules of long bones with two sharp ends. In four patients

TABLE 5.—*Location of Esophageal and Hypopharyngeal Foreign Bodies*

Type	Hypopharynx	Cervical Esophagus	Thoracic Esophagus	Cardiac Esophagus	Total
Chicken bone	1	20	6	0	27
Coin	0	15	6	0	21
Meat	0	2	2	8	12
Fish bone	1	7	1	0	9
Large bone	0	2	2	0	4
Pins	1	1	0	3	5
Food	0	0	0	5	5
Button	0	1	2	0	3
Glass	1	1	0	0	2
Other metal objects	0	5	2	0	7
Total					95

the bone was obscured by a large piece of meat to which it was attached. Removal was accomplished in all patients with local anesthesia. Most of these patients sought endoscopic consultation soon after the accident. Only five were seen more than two days after swallowing the bone. Three were seen on the third day, one (bone in hypopharynx) on the fifth, and one at the end of a week. There were no complications. One woman refused esophagoscopy, and when she returned the next day the bone was in the midesophagus and the upper portion was filled with bread crusts she had swallowed in attempting to dislodge the foreign body. For only one patient was a second esophagoscopy necessary. A 60-year-old man was admitted with the history of having swallowed a chicken bone two days before. Roentgen study showed evidence of a foreign body just below the cricopharyngeal orifice. At esophagoscopy a large piece of chicken meat was removed from the upper esophagus. There was swelling and inflammation in the region of the cricopharyngeus, but a bone could not be located. The symptoms persisted, and a recheck by roentgenogram still showed evidence of a foreign body. A second esophagoscopy on the following day revealed a piece of chicken bone embedded anteriorly beneath the plica of the cricopharyngeus.

The 21 coins were all in children under 5 years of age. Fifteen were lodged in the upper esophagus and the other six in the thoracic esophagus at the level of

the aortic arch. Removal without anesthetic was possible in 12, but 9 children were excited, crying, irritable, or struggling and general anesthesia was employed. In eight the coin had been in the esophagus for more than three days, the longest time being two weeks. In only one were there complications following esophagoscopy. A 16-month-old child from a rural community was admitted with a history of difficulty in swallowing for five days, vomiting for three days, and fever and cough for two days. The family physician was consulted on the day of admission and roentgen examination showed a coin in the upper esophagus. Physical examination showed signs of moderate acidosis and coarse rales were audible over both lungs, especially at the bases. This patient was seen in the evening after the regular operating-room force was off duty. The child was irritable and excited, and general anesthesia was deemed more suitable in this case regardless of the pulmonary findings. On esophagoscopy there was marked redness and swelling in the region of the cricopharyngeus. In the upper esophagus a mass of pink elastic material was found obstructing the lumen. This proved to be bubble gum, and embedded in the mass were two pennies. Later the mother found that an older sister had given the infant the gum and coins five days before. A rather severe bronchopneumonia followed esophagoscopy, but it subsided in five days with antibiotic therapy and parenteral feedings.

The 12 patients in whom a piece of meat was the foreign body were all adults, 45 years of age or older. Those in whom a piece of bone was present in addition to the meat have been included under the classification of the type of bone. Three were past 70 and two past 80. The level of lodgement was the cervical esophagus in two, the thoracic portion in another two, and the cardiac portion in the other eight. This small group presented more difficulties and complications than any other and included the only death in this series. In two there had been complete obstruction for as long as five days and in two others for three days. A 45-year-old woman had a lye stricture of the lower esophagus, present since childhood, which caused the meat to lodge. A 66-year-old man had a marked cardiospasm with a piece of meat lodged in the lower esophagus. After removal no other pathological condition was found, and the sphincter was dilated. The patient returned two weeks later with an obstruction again, this time a crust of bread. One perforation occurred in this group. A 53-year-old man was admitted with the history of having choked on a piece of meat one week before. He thought he had swallowed a piece of bone, but roentgen study had failed to show it. An attempt had been made to push the obstructing material into the stomach with a heavy stomach tube. For five days he had had obstruction, and he vomited when he attempted to swallow. Preliminary roentgen examination showed nothing significant, but study with barium was not made. At esophagoscopy five large pieces of meat were removed. There were swelling and evidence of previous trauma in the cardiac portion of the esophagus. After esophagoscopy, the patient had marked odynophagia, dysphagia, and slight elevation of temperature. Roentgen study with barium revealed a perforation of the esophagus with accumulation of barium in an area which the roentgenologist considered a walled-off abscess cavity in the mediastinum (Fig. 1). All symptoms cleared up with penicillin therapy. The patient signed a release and left the hospital before check-up studies were made. According to the referring physician, his recovery was uneventful. A 76-year-old woman had had an obstruction for two days, and at esophagoscopy the entire

esophagus, from the cricopharyngeus to the cardiac portion, was filled with pieces of meat and bread. An 80-year-old woman with marked kyphosis choked on turkey meat at Christmas dinner and the esophagus became obstructed. At esophagoscopy a piece of meat was removed from the midesophagus, just proximal to the angulation of the thoracic vertebrae. The only death occurred in an 86-year-old man, the oldest in this series. He was referred from a neighboring town because he had had an obstruction for three days. A roentgen diagnosis of malignant tumor of the stomach had been made previously. On admission he was found to have acidosis, his heart was enlarged, and there was evidence of cardiac decompensation. After

Fig. 1.—C. R., a man aged 53, with obstruction for five days. Previous attempt had been to dislodge the foreign material with a heavy stomach tube. Five pieces of meat were removed at esophagoscopy. Roentgen studies with barium after esophagoscopy showed perforation with abscess cavity in mediastinum. He made an uneventful recovery with penicillin therapy.

consultation it was decided to remove the obstructing material regardless of his general condition. With the patient under local anesthesia, a piece of chicken meat was removed from the lower end of the esophagus. A granulomatous area was present in the region of the cardiac sphincter. A biopsy specimen was taken. Immediately after esophagoscopy there was no evidence of unfavorable reaction to the procedure. About 12 hours later he died suddenly with characteristic symptoms of cardiac failure. Autopsy was refused. The specimen was reported as inflammatory tissue but probably would have been positive had it been taken at a deeper level.

Although more patients were seen with the history of swallowing fish bones than any other type of foreign body except chicken bones, fish bones accounted for only nine cases. Fish bones were predominant in the foreign bodies of the pharynx that could be removed by indirect procedures. Two occurred in children in the second decade, and the remainder were in adults. One lodged in the hypopharynx, seven just below the cricopharyngeal orifice, and one in the thoracic esophagus. One patient was seen in consultation in whom mediastinitis followed perforation by a fish bone. In this group no complications occurred.

Only five pins were included in the foreign bodies in this series, two straight pins and three open safety pins. One of the straight pins was lodged in the hypopharynx and the other in the lower esophagus. Both were removed without complications. The open safety pins were all in children under 18 months of age and all were lodged with the spring distal. One was lodged in the cervical esophagus and was easily removed by the point-sheathed method without anesthetic. The other two were in the lower esophagus just above the diaphragmatic hiatus, and in both cases the mother had felt the pin in the mouth but had pushed it to a lower level in attempted removal. General anesthesia was employed in both children. In one the point was deeply embedded in the wall of the esophagus on the right side, while in the other the level of lodgement was similar but the point was free. Endogastric version with forceps was attempted, as an "alnico" magneprobe, advocated by Equen,[5] was not available. In both children the version was not accomplished, and the pin was lost in the stomach. In the child with the point deeply embedded in the esophageal wall, a perforation was present. Pneumothorax and mediastinitis and later pyothorax developed. The postoperative course was stormy, requiring 30 days of hospitalization with intensive antibiotic therapy and surgical drainage of the empyema. In the other child there were no complications. Both open safety pins that were lost in the stomach passed through the intestinal tract and were eliminated without difficulty. This agrees with Delaney,[6] who reported a series of 41 cases in which foreign bodies passed through the intestinal tract of children without any serious complications.

Occasionally a foreign body lodges owing to some underlying pathological condition in the esophagus. This was true in all five patients in whom the foreign body was food, except meat, which has been considered separately. Three patients had a cardiospasm with obstruction by a piece of celery, a heavy crust of bread, and a piece of hard-boiled egg, respectively. In the other two, a stricture was present. A woman who was known to have had a lye stricture since childhood had an obstruction by a piece of carrot. In the other, a 50-year-old man, a stricture developed after a peptic ulcer of the esophagus healed. He had an obstruction by a heavy crust of French bread. Esophagoscopy was repeated one or more times in all the patients except the one with a lye stricture, who did not return for check-up examination. The subsequent procedures, with one exception, were not for removal of a foreign body but for dilatation of the obstructing pathological condition.

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5. Equen, M.: Magnetic Removal of Foreign Bodies from the Food and Air Passages, Arch. Otolaryng. **46**:225-229 (Aug.) 1947.

6. Delaney, C. J.: Foreign Bodies Swallowed by Children, New York J. Med. **40**:1024-1026 (July) 1940.

In two patients a piece of glass was the foreign body. One piece was removed from the hypopharynx and the other from the upper esophagus. In each, lacerations were present either in the hypopharynx or in the region of the cricopharyngeus. Both patients required hospitalization and treatment with penicillin. In another patient glass was suspected but was not found by esophagoscopy. There was a deep laceration extending from the cricopharyngeal sphincter down into the esophagus. This was probably the most painful of the cases in the adult group. No complications occurred, but hospitalization with antibiotic therapy and intravenous feeding was required.

Of the seven other esophageal foreign bodies, four were easily removed from the cervical esophagus but the other three presented some difficulties. A large locket and a big metal coat button were lodged in the thoracic esophagus at the level of the aortic arch and were removed with the patients under general anesthesia. The button had been lodged for two weeks, and the child was referred to a pediatrician because of projectile vomiting and dehydration. After removal, his convalescence was uneventful. A marble was the only foreign body that had to be removed by an external operation. This case has been reported by Dr. John H. Foster,[7] who saw the patient in consultation. A 5-year-old boy was brought to the hospital with the history of choking on a marble. Examination revealed a child with slight dyspnea and a wheezing type of respiration. Esophagoscopy with the child under general anesthesia disclosed a glass marble embedded in the region of the cricopharyngeal sphincter. It was impossible to pass any type of instrument between the marble and the esophageal wall, and it could not be pushed downward into the esophagus. Dr. Foster confirmed these findings. Twelve hours later the findings were unchanged, and an external approach was made. The esophagus was identified and by dissection freed to a point where the marble could be palpated. With fingers around the esophagus the position of the foreign body could not be changed. It was removed through a horizontal incision. The mucosa of the esophagus at the point of lodgement showed evidence of contusion, and the cricopharyngeus showed hemorrhage into the muscle fibers. The child made an uneventful recovery. Further questioning revealed that the mother had attempted to remove the marble and pushed it downward. The assumption for these findings is that the marble was forcibly pushed into the cricopharyngeal sphincter causing a separation of the fibers which contracted in a spastic manner around the foreign body.

TRACHEOBRONCHIAL FOREIGN BODIES

Delay in diagnosis was more frequent with the tracheobronchial foreign bodies. All occurred in children under 5 years of age. Only two in adults were seen; both adults had a history of swallowing a foreign body, the physical and roentgen signs were suggestive, but no foreign body was found by bronchoscopy. Failure to recognize a foreign body in the air passages could be attributed to three major causes. First, the initial episode of choking, gagging, or coughing was not observed or heard, resulting in negligence in securing medical assistance. Second, the first physician consulted failed to interpret the signs and symptoms as related to a

7. Foster, J. H.: Impacted Foreign Body in the Esophagus Requiring External Operation for Removal, Ann. Otol. Rhin. & Laryng. **53**:795-796 (Dec.) 1944.

foreign body. Third, the widespread and indiscriminate use of chemotherapy and antibiotic therapy has masked some of the classic physical findings.

Of the 13 tracheobronchial foreign bodies, 9 were due to vegetal material, 1 to a metal object, another to a bone, and the other 2 to endogenous mucous plugs. In six cases the foreign body had been lodged five days or more. In two it had been present for 7 days, in one for 12 days, in another for 3 weeks, and in one for 4 weeks. The major problem presented by metallic objects lodged in a bronchus is the symptomless interval described by Jackson and Jackson,[8] which may be long, and complications may occur before the object is suspected. Vegetal matter, such as nut kernels, beans, or seeds, when lodged in the trachea or bronchi cause an irritation which is followed by an arachidic bronchitis or pneumonia.

LARYNGEAL FOREIGN BODIES

Foreign bodies in the larynx produce symptoms according to the size, location, and amount of obstruction produced. The only one of this series that was lodged in the larynx was a small pine cone. An 8-month-old infant was lying on a blanket in the yard and had a sudden episode of gagging and choking. The mother, suspecting a foreign body, tried to remove it with her finger. She felt a small pine cone but it passed to a lower level in the attempted removal. Signs of laryngeal obstruction immediately developed, with wheezing, indrawing, and cyanosis. The child was rushed to a general hospital in an adjacent city where the emergency was recognized and a tracheotomy was performed. Removal by direct laryngoscopy was unsuccessfully attempted. About eight hours later the child was seen in consultation. On examination there was marked swelling of the hypopharynx and larynx. A small green pine cone was tightly wedged in the subglottic area of the trachea with the point of the cone extending up between the vocal cords. The base, or stalk, extended down into the trachea. Removal was accomplished without anesthesia, but several of the segments, or sporophylls, came off, necessitating a bronchoscopy. Convalescence was uneventful except for dysphagia secondary to the trauma of the hypopharynx and larynx.

TRACHEAL FOREIGN BODIES

Tracheal foreign bodies produce symptoms according to their size and location. Some may be symptomless; however, the pathognomonic signs, according to Jackson and Jackson,[1] are an "audible slap," a "palpitory thud," and an "asthmatoid wheeze." McCrae[9] described a "tracheal flutter" heard in the case of a watermelon seed. Cough, hoarseness, dyspnea, and cyanosis are the more serious signs. Three other tracheal foreign bodies were seen in addition to the pine cone, which was of sufficient size to be lodged in both trachea and larynx. One child with a watermelon seed had the typical findings, and it was easily removed under general anesthesia. A second boy was seen with all the characteristic signs and symptoms but evidently expelled the seed in a seizure of coughing in the induc-

8. Jackson, C., and Jackson, C. L.: Foreign Bodies in the Lung, Am. J. Surg. **54**:211-214 (Oct.) 1941.

9. McCrae, T.: Foreign Bodies in Bronchi, Lancet **1**:735-741 (April 12) 1924; **1**:787-793 (April 19) 1824; **1**:838-841 (April 26) 1924; abstracted, J. Laryng. & Otol. **39**:324-334 (June) 1924.

tion stage of the general anesthesia. Of the entire series, a kernel of popcorn (swollen by heating) presented the only emergency in which the patient's life was in danger. She was rushed in by ambulance from a city 115 miles away where bronchoscopic consultation was not available. On arrival there was marked indrawing and cyanosis. An emergency bronchoscopy disclosed a swollen grain of popcorn lodged at the carina, functioning as a check valve and producing bilateral obstructive emphysema. Slight vegetal tracheobronchitis, which responded to penicillin, was the only postoperative complication. A 2-year-old girl choked on a piece of pork-chop bone, and it was forced into the trachea when removal was attempted. The bone was a large triangular piece which was lodged just below the vocal cords. It was of sufficient size to cause marked dyspnea, and in attempted removal it would have stripped off at the cords. A tracheotomy was performed, and under general anesthesia the bone was removed without injury to the vocal cords. The child had a very severe tracheobronchitis which subsided after eight days of penicillin therapy.

BRONCHIAL FOREIGN BODIES

With bronchial foreign bodies, after the initial symptoms of coughing, choking, and wheezing, there is usually a symptomless interval of varying degree. The physical signs are determined by the degree of bronchial obstruction and infection present. Jackson and Jackson [1] describe bronchial obstruction as being (1) bypass-valve obstruction, (2) check-valve obstruction, and (3) complete obstruction. In the first there may be no physical finding, in the second the lungs become emphysematous, and in the last atelectasis develops. Obstructed emphysema was first described by Iglauer.[10] Roentgen study is of paramount importance in the diagnosis of foreign bodies of the bronchi. Manges'[11] studies have shown the mechanism by which nonopaque foreign bodies in the bronchi produce emphysema, atelectasis, or other pulmonary complications. In either emphysema or atelectasis there is a corresponding shift of the mediastinum and its structures. Roentgen studies should be made at full inspiration and at the end of complete expiration. This was attempted in all patients, but in some infants and small children it was difficult (Table 6).

The opaque foreign body presents no problem in diagnosis unless it is symptomless. In the one patient with a metallic foreign body, an empty .22 rifle cartridge had been lodged in the right main bronchus for three weeks. There was atelectasis of the entire right lung. The boy had been erroneously treated for lobar pneumonia. After removal of the foreign body by bronchoscopy, the pathological condition of the lung subsided.

The remaining eight bronchial foreign bodies included six of vegetal origin and two of endogenous origin. Delay in diagnosis of four of the six vegetal foreign bodies occurred. Only two patients, one with a piece of pecan kernel and one with a piece of peanut, were seen within six to eight hours after the accident. In both, obstructive emphysema was present. In the other four patients with foreign bodies

10. Iglauer, S.: Tracheobronchoscopy with Report of Cases, Ohio M. J. **7**:178-183 (April) 1911.

11. Manges, W. F.: The Roentgen-Ray Diagnosis of Non-Opaque Foreign Bodies in the Air Passages, Am. J. Roentgenol. **9**:288-304 (May) 1922.

of vegetal origin, the time varied from one to four weeks. Atelectasis was present in all four, and one could have been classed as having a "drowned lung."

A child had been sick for four weeks, and a foreign body was not suspected until a consulting pediatrician diagnosed atelectasis of the right lower lobe. Bronchoscopy revealed a mass of granulations in the distal part of the right main bronchus. A piece of pecan kernel was found in the mass of granulation tissue, and after removal a large amount of pus was aspirated. The pathological condition of the lungs appeared extensive, but the roentgen signs cleared up after removal of the foreign body. A bronchoscopy two weeks later showed only a few granulations and very slight scarring where the pecan had been embedded. There was no stenosis of the lumen of the bronchus. A 2½-year-old child was diagnosed as having atelectasis of the right lung, and the mother remembered that the child strangled while eating seven days before. A large piece of black-walnut kernel was found

TABLE 6.—*Tracheobronchial Foreign Bodies*

Case No.	Type of Foreign Body	Location	Roentgen Finding	Complication
83	Small pine cone	Larynx	Negative	Tracheotomy before admission; pneumonia
47	Watermelon seed	Trachea	Negative	None
75	Popcorn	Trachea (carina)	No examination	Mild pneumonia
105	Pork-chop bone	Trachea (subglottic)	Bilateral obstructive emphysema	Tracheotomy; bronchopneumonia
120	Pinto bean	Left main bronchus	Atelectasis, left lung	Foreign body fragmented; arachidic bronchopneumonia
38	Peanut	Right main bronchus	Atelectasis, right lower lobe	None
15	.22 Rifle shell	Right main bronchus	Atelectasis, right lung	None
107	Peanut	Left main bronchus	Emphysema, left lung	None
45	Mucous plug	Right upper lobe bronchus	Atelectasis, right upper lobe	None
54	Pecan	Right main bronchus	Emphysema, right lung	None
74	Black walnut	Right main bronchus	Atelectasis, right lung	Dislodged into left main bronchus
84	Pecan	Right main bronchus	Atelectasis, right lower lobe	None
107	Mucous plug	Right main bronchus	Abnormal density of right lung; displacement of heart	Congenital maldevelopment of right lung; thoracic surgery

lodged in the right main bronchus. In removal it stripped off at the vocal cords, and a second bronchoscopy was necessary, this time to remove it from the left main bronchus. A pinto bean presented difficulties and complications. The father remembered the child choking but did not consider it important. Seven days later the child had a fever and was diagnosed as having atelectasis of the left lung. At bronchoscopy the bean was found to be very swollen, and the surrounding bronchial mucosa was edematous and inflamed. The bean was fragmented in removal, but all parts were recovered. This child had the severest arachidic bronchitis of any in the entire series. In another child a piece of peanut had been lodged in the right main bronchus for 12 days. The child had been under treatment for pneumonia. Treatment with penicillin caused temporary improvement, but the symptoms and fever recurred. Roentgen examination disclosed atelectasis of the right lung. After bronchoscopic removal of the foreign body, the atelectasis and other symptoms of pathological condition of the lungs promptly subsided.

The two bronchial foreign bodies of endogenous origin were both mucous plugs. One was caused by aspiration, and the other was secondary to infection. A 5-

month-old infant strangled when an older brother put a small piece of candy in her mouth. Coughing followed the incident but was forgotten until fever developed. Roentgen examination showed atelectasis of the right upper lobe. At bronchoscopy five days after the accident a plug of mucus was aspirated from the opening to the right upper lobe. Whether or not it had been due to the candy could not be determined. The infant promptly recovered after bronchoscopy. A 22-month-old boy was referred by a physician in an adjacent town with the diagnosis of atelectasis of the right lung due to a nonopaque foreign body. He was consulted when the child became sick with a cough and fever. Examination revealed dulness and absence of breath sounds over the right lung. Roentgen examination showed an abnormal density of almost the entire right lung with marked displace-

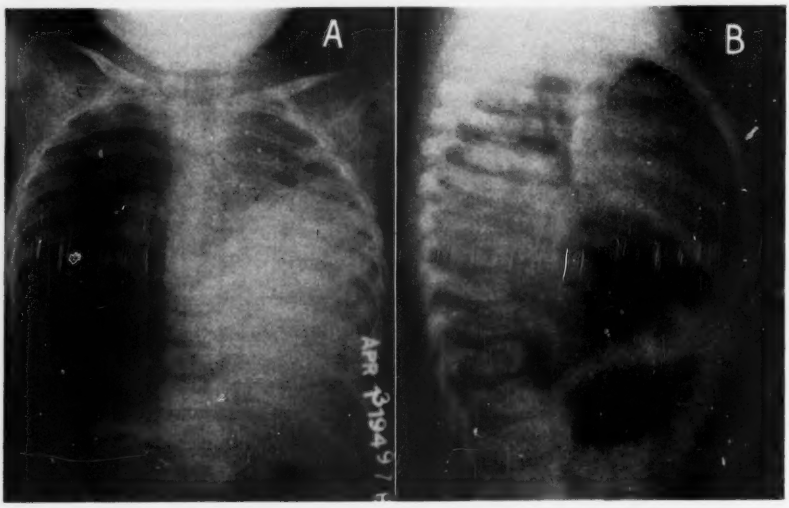

Fig. 2.—*A*, J. L. W., aged 22 months. (Photographs show reverse of roentgenograms.) Abnormal density of almost entire right lung with displacement of the heart. *B*, lateral view of same patient.

ment of the heart to the right (Fig. 2). The mother recalled that the child strangled while eating about two days before the onset of the illness. The physical and roentgen findings were confusing. It was the roentgenologist's opinion that the findings were probably caused by a congenital malformation of the right chest and lung. A diagnostic bronchoscopy revealed the mucosa of the trachea and bronchi to be subacutely inflamed. Just distal to the carina the right main bronchus was compressed and the lumen filled with inspissated mucus. After aspiration the bronchus was found to be obliterated distally. Later exploration of the right side of the thorax revealed protrusion of the liver up through the diaphragm with displacement of the heart to the right and maldevelopment of the middle and lower lobes of the lung. The parents had not detected any abnormality in the child, except retarded development, until the onset of the acute respiratory infection.

SUMMARY AND CONCLUSIONS

1. A series of 108 cases of foreign bodies in the air or food passages has been reviewed. All occurred in private patients treated in a small hospital without an organized endoscopic department.

2. Alteration in the usual endoscopic technique was necessary because of lack of trained assistants. The mechanical head rest was satisfactory for most procedures in adults, but head-holding was employed for children.

3. Local anesthesia was used in all adults, but general anesthesia was employed in 25 children.

4. Of the patients, 56 were adults and 52 were children. All tracheobronchial foreign bodies occurred in children under 5 years of age.

5. The foreign bodies most frequently encountered were bones (37.9%), coins (19.5%), and meat (11.1%). Chicken bones were most frequent, accounting for 25% of the entire series.

6. Delay in diagnosis was infrequent in foreign bodies in the food passages but occurred in 46% of the tracheobronchial foreign bodies.

7. Delay in diagnosis of tracheobronchial foreign bodies was due to lack of history of the accident, failure of the first physician consulted to correlate the findings with those of a foreign body, and masking of symptoms by chemotherapy and antibiotic therapy.

8. Perforation of the esophagus occurred in two patients, but in neither was fatal.

9. One death occurred in this series, a mortality rate of 0.92%.

10. Two tracheotomies were necessary. One, for a pine cone impacted in the larynx, was performed before the patient was referred for bronchoscopic treatment. The other was performed to relieve obstruction caused by a large piece of bone in the trachea before it was removed under general anesthesia.

11. Two open safety pins were lost in the stomach but passed through the intestinal tract without complications.

12. External operation was necessary to remove a marble embedded in the cricopharyngeal sphincter.

13. Atelectasis was present in five of the patients with bronchial foreign bodies and obstructing emphysema in two.

14. A congenital malformation of the right chest produced physical findings and roentgen signs which had to be differentiated from those of a nonopaque bronchial foreign body.

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EFFECTS OF PERFORATIONS OF THE TYMPANIC MEMBRANE ON COCHLEAR POTENTIALS

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HISTORICALLY, three positions regarding the effects of perforation of the tympanic membrane have been held. Cooper,[1] Toynbee,[2] Treitel,[3] Bingham,[4] and, more recently Crowe and Hughson [5] believed that little loss of hearing resulted from such perforations. In addition to some classic otologists,[6] Minton [7] and Békésy [8] believed that disorders in the transmission apparatus affected chiefly the low tones, while they did not modify the perception of high tones or, at least, modified them in much less degree.[6] Lorente de Nó,[9] Pohlman,[10] and Bordley and

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This research was supported in part by the Office of Naval Research, under Contract N6-ONR-270, T. O. 3, Project NR 140-322. Permission is granted for reproduction, translation publication, use, and disposal in whole or in part by or for the United States Government.

This work was also aided by Higgins Funds allotted to Princeton University.

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10. Pohlman, A. G.: The Reactions in the Ear to Sound, Ann. Otol. Rhin. & Laryng. **50**:363-378, 1941.

Hardy [11] thought the tympanic membrane to be as important for the reception of the high tones as for the reception of the low tones.

This study, in an attempt to clarify the controversy, shows the effects of perforations of the tympanic membrane on the cochlear potential responses of the ear. Effects of both the area and the location of perforation are evaluated.

PROCEDURE

The cat was used as an experimental animal. Each animal was deeply anesthetized with diallylbarbituric acid injected intraperitoneally and was maintained at a constant physiological level by artificial respiration. Curare was injected into the femoral vein in an amount sufficient to suppress all reflexes and respiratory activity. A mediolateral operation exposed the bulla, and a large opening was made to give good exposure of the round window membrane. The pinna and external auditory meatus were removed in order to give a good exposure of the tympanic membrane.

The animal was placed so that its tympanic membrane was located at the end of a tube through which pure-tone stimuli of 100 to 10000 cps were conducted from a loud-speaker. A ground electrode was placed in muscle, and cochlear potentials were picked up by a platinum foil

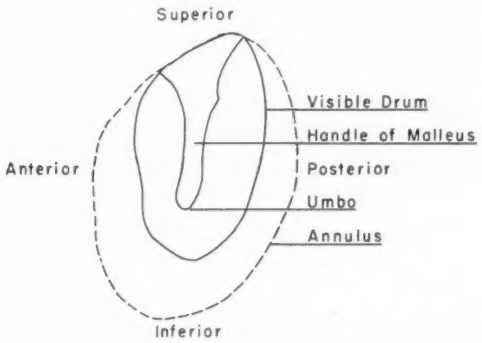

Chart 1.—Left tympanic membrane of the cat (view from the external meatus).

electrode placed on the round window membrane. These were amplified and conducted to a wave analyzer (General Radio Type 736-A) used as a selective voltmeter. Readings were expressed in microvolts.

A reading with the normal intact tympanic membrane was made in which the sound intensity necessary to give a 10 μv. output was recorded. A perforation was then made in the tympanic membrane by means of an electrocautery with an especially fine cutting point. Two readings were made at each frequency—(1) the voltage output given by the same sound intensity used to obtain the previous reading for that frequency and (2) the new sound input necessary to give an output of 10 μv. The perforation was enlarged, and the same two types of readings were obtained. Enlargement of the perforation was continued until the membrane was entirely gone, at which time a final reading was made for each frequency.

The general nomenclature of the tympanic membrane is shown in Chart 1. The annulus is not observable from the external meatus, but its inner edge is shown to give an idea of the relative area of those structures which are directly visible from the outside.

Three types of perforation were made, which for convenience are referred to by the points at which the perforation was begun. 1. "Anterior" or A-type: perforation was begun in the anterior-superior region of the membrane, and each enlargement was carried out in the inferior direction

11. Bordley, J. E., and Hardy, M.: Effect of Lesions of the Tympanic Membrane on the Hearing Acuity, Arch. Oto-laryng. **26**:649-657, 1937.

until the umbo was passed, and from that point on the enlargements were made superiorly. 2. "Posterior" or P-type: a similar procedure was followed with perforations in the posterior region. The incision began in the superior portion and was extended inferiorly, around the umbo, and then superiorly. 3. "Umbo" or U-type: perforations in the umbo region were begun directly below the tip of the handle of the malleus. Enlargements were then made superiorly by working alternately on either side, first on the anterior and then on the posterior region of the membrane. Each puncture is referred to by type in the section on results.

The form and location of each perforation were plotted on graph paper by observation through a microscope with a gridded reticle inserted in one lens. At the conclusion of the last frequency readings (no membrane present) the annulus, a bony ring containing the tympanic membrane, was removed and plotted at the same depth of focus as were plots of the perforations in order to give the true area of the membrane. Plots of each perforated membrane and its annulus were placed on the same graph paper, and extrapolations of perforated areas were made to give a truer picture of the actual excised area than that revealed by view from the external meatus. The area of each perforation was found by measuring the drawings with a compensating polar planimeter, and percentage of membrane loss in each instance was obtained by dividing this area by the area of its corresponding annulus.

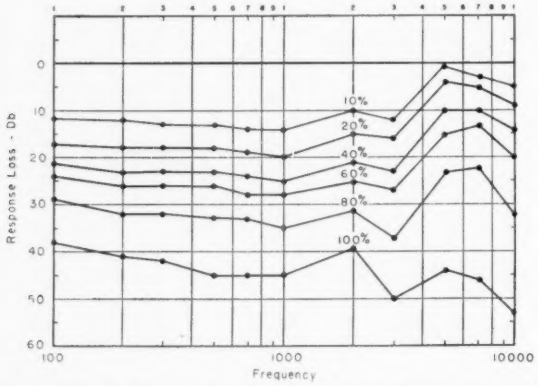

Chart 2.—Average loss of response in decibels for various degrees of membrane damage.

Cochlear potential readings of each animal with the membrane intact were used as an index of normal response. Changes in response in decibels for each perforation were measured from this level, and the percentage of change of response was computed. Results are reported on 9 animals, although data were obtained on 14. The five animals not reported had only a small number of enlargements of each perforation, but the results were wholly consistent with those reported here.

RESULTS

Perforation of the tympanic membrane caused a general loss in response throughout the frequency range tested. Decibel losses at each frequency were averaged together for a certain percentage of membrane removed regardless of the type of perforation. These averages of all nine animals show the effects of the area of membrane removed (Chart 2). Until the entire membrane was removed the general response function was not radically altered in shape by increased size of the perforation, although, generally, larger losses occurred for the initial 10% removed than for any further enlargement of 10%. Response loss for frequencies below 2000 cps was fairly uniform and was greater than response loss for frequencies above 2000 cps up to the point of removal of the greater portion of the

membrane. When the remaining portion of the membrane was removed this relationship was inverted. Response to the high frequencies was even more seriously impaired than to the range of low frequencies.

Effects of location of perforation at each frequency are shown in Charts 3, 4, and 5. A P-type lesion caused large response losses at the low frequencies (Chart 3*A*). A small perforation caused a large response loss, and the bend of the curve was passed by removal of less than 40% of the membrane. Response

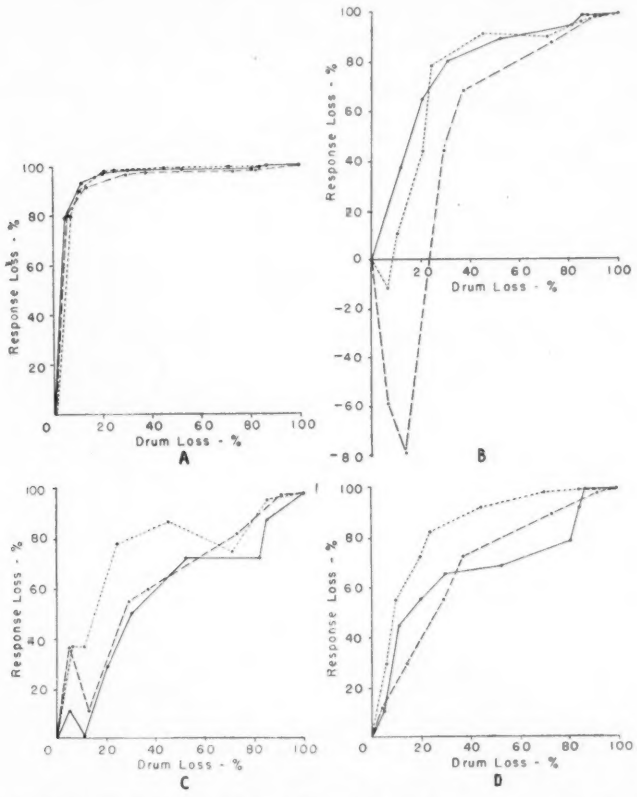

Chart 3.—Response losses for membrane losses—P-type lesion: *A*, composite graph for low frequencies, 100 to 2000 cps; *B*, 5000 cps; *C*, 7000 cps; *D*, 10000 cps.

losses at 5000 cps (Chart 3*B*) were less than they were at the low frequencies for removal of the same amount of membrane. Also, responses at this frequency were not as consistent between animals as they were at the lower frequencies. In two animals the responses were improved above the normal level, as shown by the small-dash and the large-dash curves in Chart 3*B*. Such improvement occurred only with a small lesion and disappeared in both cases when the lesion was enlarged to include 25% of the membrane. In the ear represented by a solid line, there

was no perforation so small as those which caused improvement in the other ears, and so we cannot determine whether or not this ear would have acted as the other two did. The curves for a P-type lesion at 7000 cps (Chart 3*C*) show variability. They seem to have a rather slight rate of rise when compared with the curves for lower frequencies. Two ears (large-dash line and solid line) showed reversal in direction of the curves with further enlargement of the lesion from the response loss caused by a small lesion. Still further enlargement, however, reversed the direction once again and caused a considerable response loss. The curves at 10000 cycles (Chart 3*D*) are less variable than they are at 7000 or 5000 cps. They appear somewhat flatter than the curves for lower frequencies.

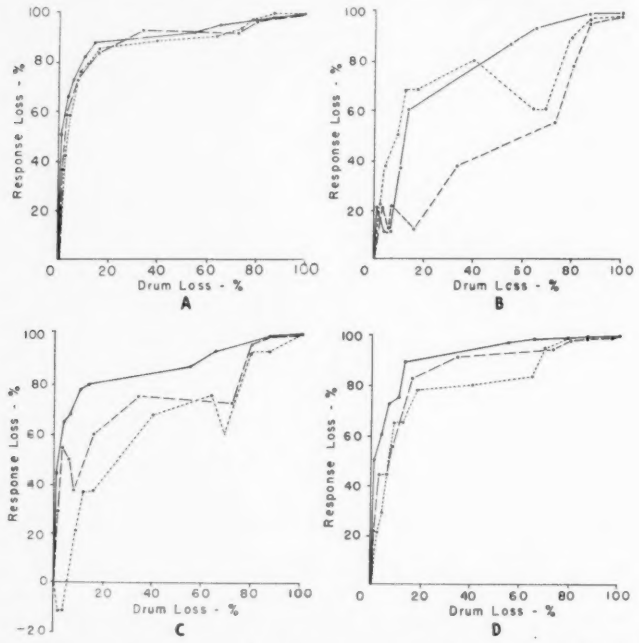

Chart 4.—Response losses for membrane losses—A-type lesion: *A*, composite graph for low frequencies, 100 to 2000 cps; *B*, 5000 cps; *C*, 7000 cps; *D*, 10000 cps.

An A-type lesion (Chart 4*A*) produces curves for the lower frequencies which are somewhat flatter than those produced by the P-type lesion for the same frequencies (Chart 3*A*). The A-type lesion curves are stable and show little variability. The curves are more variable at 5000 cps (Chart 4*B*), however. In two instances (large-dash line and solid line) the response function was reversed in direction from the loss level caused by a very small lesion, as Chart 4*B* shows by the dips in the solid and large-dash curves. These reversals disappeared with removal of an additional small amount of membrane. The curves at 7000 cps (Chart 4*C*), while still variable, are a little sharper than those at 5000 cps. One ear (small-dash line) showed a gain in response above the level of the normal intact membrane. Further

removal of membrane caused a loss from this level, however. Another ear (large-dash line) showed a reversal of the function from the response loss caused by a small membrane loss. Removal of more membrane reversed this response once

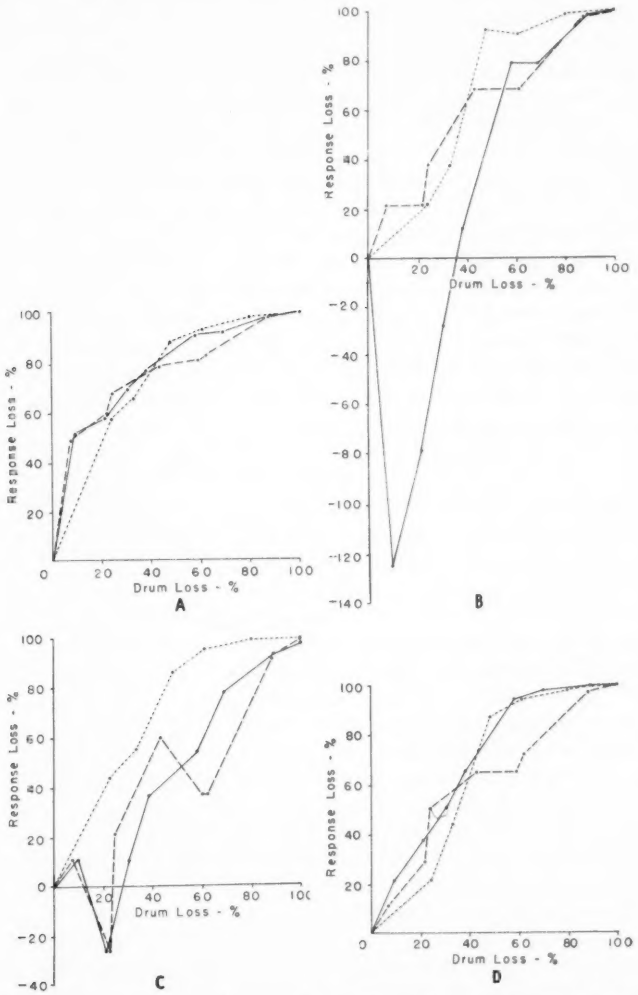

Chart 5.—Response losses for membrane losses—U-type lesion: *A*, composite graph for low frequencies, 100 to 2000 cps; *B*, 5000 cps; *C*, 7000 cps; *D*, 10000 cps.

again and caused a response loss. The curves at 10000 cps (Chart 4*D*) are sharper and less variable than they are at 7000 or 5000 cps. Also the curves for the A-type lesion are sharper than curves for the P-type lesion at the same frequency (Chart 3*D*).

Response loss for perforation of the U-type was less at every frequency than response loss for the same sized perforation of the other types. Curves for the U-type lesion for the lower frequencies (Chart 5*A*) are flatter and show somewhat more variability than do the curves for the other types of a lesion for the same frequencies (Charts 3*A* and 4*A*). Curves for the U-type lesion at 5000 cps (Chart 5*B*) are more variable than curves for the lower frequencies. A very great improvement in response at this frequency was caused by a perforation in the ear represented by a solid line. Response was improved up to a point 125% above the response level of the normal intact membrane. Neither of the other two ears with this type of lesion, however, showed an improvement of response, although perforations were made in these ears which were as small as some of the perforations which caused the response gain for the ear represented by a solid line. The curves for the U-type lesion at 7000 cps (Chart 5*C*) are variable. Two ears (large-dash line and solid line) showed an initial response loss with a small lesion and then a reversal of function and a gain above the level of the normal intact membrane with an enlargement of the lesion. Further enlargement produced a response loss once more. The U-type lesion curves at 10000 cps (Chart 5*D*) are less variable than they are at 7000 or 5000 cps. The U-type-lesion curves are relatively flat at this frequency, more nearly approaching a linear form than the curves for the other types of lesion.

COMMENT

Interpretation of Results.—The area of membrane removed has important effects (Chart 2). Removal of the initial 10% of membrane produced greater losses than any additional removal of the same magnitude. Each removal produced losses at all frequencies, however, which followed the same general pattern as the losses on removal of the initial 10% of the membrane. The low frequencies are more affected than the high frequencies by a given membrane loss up to a loss of the greater portion of the membrane, even though inclusion of the results at 5000 and 7000 cps tends to diminish the difference.

Our results indicate that the pattern of response loss caused by removal of a small amount of membrane is chiefly dependent on the location of the membrane removed. The sharp rise in the curves for P-type lesions with small membrane loss for the lower frequencies (Chart 3*A*) indicates that the posterior region of the membrane is more important for these frequencies than the other regions are. Further indication of the importance of the posterior region is the sudden rise in the A-type-lesion curves for the lower frequencies (Chart 4*A*) with removal of the last 30% of membrane. According to our operating procedure, the last 30% of an A-type lesion is membrane from the same position as the first 30% of the P-type lesion, i. e., membrane is removed from the superior portion of the posterior region of the membrane.

At 5000 and 7000 cps the great instability of response and the large variability produced equivocal results. At these frequencies small lesions of the A-type and of the P-type produced results which are equivalent. With a lesion of the same size, a few ears with a P-type lesion showed a greater loss than some ears with an A-type lesion, but also a few ears with an A-type lesion showed a greater loss than some with a P-type lesion.

In purely physical systems resonance characteristics produce great instability of response at the resonance peak. Resonance characteristics may be used to explain our results at 5000 and 7000 cps. Our curves (Charts 3*B*, 4*B*, 5*B*, 3*C*, 4*C*, and 5*C*) reveal large variability at these frequencies. Responses also were unstable, as shown by the fact that in each type of lesion at least one ear showed either a reversal in direction of the function or a gain above the level of the normal intact membrane with membrane loss. This is just the response pattern to be expected in the region of a resonance peak. Earlier work [12] has also shown that resonance peaks for the cat's ear occur somewhere within this frequency range.

It appears that the anterior region of the membrane has a slightly greater effect at high frequencies than do the other regions. This is definitely true at 10000 cps, as small A-type lesions produced in every case larger response losses at this frequency than were produced by removal of the same amount of membrane in the other types of lesions.

In a purely physical system, responses on either side of a resonance peak are more stable and show less variability than responses at the peak. In our data, Charts 3*D*, 4*D*, and 5*D* for 10000 cps show the stable and nonvariable characteristics expected on a basis of resonance peaks occurring at 5000 or 7000 cps. It is unfortunate that we do not have data for effects at other frequencies above 10000 cps, as this would give us a better indication as to whether the apparent increase of stability of response at 10000 cps is an experimental artefact or a real effect for frequencies well above the resonance peak of the ear.

Throughout the entire frequency range lesions of the U-type caused smaller response losses than lesions of the other types. Also results of U-type lesions were less stable than results of the other types of lesions for the same frequency.

Implications of these Results.—The classic otologists believed that a lesion in the tympanic membrane produces no hearing loss for the high tones but affects only the low tones. We found that a lesion in the membrane produces a response loss for all frequencies, but with the same amount of membrane removed up to the greater portion of the membrane loss for the high frequencies is less than loss for the low frequencies. Since the otologists observed damaged ears in which the location of the perforation was not controlled and since they had crude methods of controlling the intensity of their stimuli, the losses at the high frequencies may not have been detected by their measuring instruments.

Our results indicate that the membrane responds differently to different frequency ranges. For frequencies below 3000 cps the posterior region is certainly more important than are the other regions. The results for different animals are consistent in this respect when tests are made with these frequencies. At 5000 and 7000 cps the membrane loses its characteristic of consistency of response, and individual animals show different response-loss patterns. At 10000 cps (and probably at higher frequencies, although they were not measured) the anterior region of the membrane is more important than are the other regions. At this frequency consistency from animal to animal appears once more.

Further evidence for difference of responses from the anterior and posterior regions of the membrane has come from measurements of the thickness of the

12. Wever, E. G., and Lawrence, M.: The Transmission Properties of the Middle Ear, Ann. Otol. Rhin. & Laryng. **59**:5-19, 1950.

membrane. It was found that on a line about half way from the tip of the malleus handle to the superior rim of the membrane the anterior region of the membrane is slightly thicker than the posterior. Such differential thickness is one factor that would lead us to expect a differential effect of the different regions of the membrane.

SUMMARY

Cochlear potentials were taken from cats that had portions of their tympanic membrane removed in the anterior, posterior, or umbo region. Each area of removal was enlarged gradually, and readings were made until the entire membrane was gone. Measurements were made of percentage of membrane removed. Results are expressed as percentage losses of response for percentage of membrane removed. Results were:

1. For frequencies of 100 to 2000 cps, small lesions in the posterior region of the membrane cause greatest response loss, small lesions in the anterior region next greatest loss, and small lesions in the umbo region least loss.

2. For frequencies of 5000 and 7000 cps, responses are equivocal and very unstable.

3. For the frequency of 10000 cps, small lesions in the anterior region cause greatest loss, small lesions in the posterior region next greatest loss, and small lesions in the umbo region least loss.

4. No matter where the lesion is located, a loss occurs for every frequency.

5. For small lesions the position of the lesion is the chief determinant of response loss.

6. For a given amount of membrane removed, losses for frequencies above 2000 cps are less than for frequencies below 2000 cps until almost the entire membrane is gone.

7. Increasing the size of a lesion does not alter the general shape of the response function until the last stage is reached in which the entire membrane is removed.

Implications of theory as to the pattern of tympanic membrane action are discussed.

SUBTOTAL RHINOPLASTY WITH FREE GRAFTS AND CONTIGUOUS FLAPS

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NEW YORK

THE RECONSTRUCTIVE procedures in a variety of nasal deformities not limited to cutaneous losses alone but including defects of varying magnitude of the entire nasal wall are grouped together under the term subtotal rhinoplasty. In the repair of these deformities the surgeon has a choice of a variety of procedures. Frequently for repair of a relatively small nasal defect he will resort to a large, distant flap, perhaps of the sickle-flap variety, or to a cervical or brachial skin tube. Nevertheless, his first consideration will always be whether a satisfactory reconstruction can be effected either by a free graft, utilizing the principle of a composite auricular graft, or by a contiguous skin flap. These procedures offer the advantage of great economy of time and effort, and in properly selected cases they will bring about a better result than can be obtained from a distant flap. The anticipated secondary scarring or deformity of the donor area must be given careful consideration, and its importance in the individual case must be carefully weighed against the advantage of the procedure. The choice of procedure must be individualized, not only in terms of technical considerations, size, character, and location of the defect, but also from the general point of view of the patient, his age, his attitude, and his cooperation.

In an elderly patient with a postmalignancy nasal defect, an adjacent facial flap may offer the possibility of immediate and simple repair with great economy of time and effort. In this instance, the resulting scar on the face would not constitute an objection. For another patient, in repair of a similar defect, maximum cosmetic effect may be the desirable goal, and a longer and more involved procedure would be indicated to avoid additional facial scarring.

It is my intention in this paper to present my experience in several cases in which such nasal deformities were corrected by free grafts and contiguous flaps. In some of the cases presented here the nasal defect was only part of an extensive facial injury, a circumstance which affected the choice of procedure.

FREE GRAFTS

For surface replacement my preference has always been the free-skin graft. The selected full-thickness skin graft, the postauricular and supraclavicular, were most frequently used, since they undergo the least color change and blend best with the facial tissue. The postauricular graft was used for limited defects and had the advantage of a completely concealed secondary scar (Case 1). Use of the supraclavicular region permitted the removal of much larger grafts, large enough to resurface the entire nose.

In cases of extensive facial burns, in which large areas required skin grafting, thick-split grafts were used for the nose. Selected full-thickness grafts, if available, were usually reserved for paraorbital resurfacing. While the split-skin grafts differ to some extent in texture and color from the normal facial skin, they are not objectionable if the entire nose is resurfaced uniformly, and they are much less conspicuous on the nose than elsewhere on the face. The grafts were placed on a smooth surface, often a scar base, avoiding the exposure of nasal cartilages and the tissue between them.

The success of free grafts on such an irregular surface as the nose depends chiefly on evenly distributed postoperative pressure. This was achieved by the

Fig. 1.—Above (Case 1), left, ulcerative radiodermatitis of nasal tip, columella, and part of ala, five years after radiation treatment of hemangioma; ulceration involved the alar cartilage. Center, because of suspicion of malignancy, the alar margin was sacrificed; involved area was resurfaced with full-thickness postauricular-skin graft which included a cartilaginous ridge for reconstruction of the sacrificed alar margin. Right, two years after reconstruction, note smooth outline of nostril. Skin graft retained a pinkish tone for six months, gradually faded down to normal, was noticeable only because of absence of freckles. Below (Case 2), left, severe facial burn involving nose; center and right, nasal dorsum was resurfaced with split graft; retraction of nostrils was corrected six months later with composite grafts from helices. Note reconstruction of helices. Right helix was repaired with a mastoid flap. Left one was closed by approximation, as the composite graft from this side was smaller than that from the right ear.

tying of sutures over the dressing, an almost routine maneuver in free grafts around the head and neck. Complete take was the rule. In one case, however, in which a free-skin graft was placed over a deep layer of the dermis after excision of a hemangioma, repeated development of sebaceous-like cysts made the result cosmeti-

cally unacceptable, and the graft had to be replaced with a cervical flap. No attempt was made to correct contractures already present, because of the tendency of all free grafts to shrink. The typical retraction of the nostrils seen in severe burns was corrected in a subsequent stage, either by a composite graft (Case 2) or by a sliding of the side of the nostril combined with a full-thickness graft (Case 3).[1]

The introduction of the composite auricular graft has opened a new field in the repair of small defects around the nostrils and nasal tip.[2] An auricular graft can be

Fig. 2 (Case 3).—Left, extensive facial burn involving nose; marked retraction of right nostril (reproduced from kodachrome®). Right (by courtesy of the Army Museum of Pathology), defect corrected by sliding of nasal wall and application of diamond-shaped full-thickness skin graft as illustrated in diagram (Fig. 3).

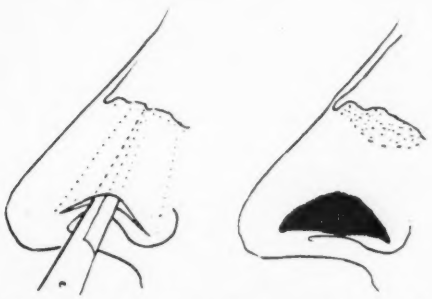

Fig. 3.—Diagram of procedure in Case 3: Through incision parallel to retracted nostril, skin on nasal wall was undermined until nasal bone was reached. The deep layer of nasal wall with the mucosa was then severed from the pyriform aperture, and the side of the nose was sufficiently mobilized until it could be slid downward to correct the retraction. Skin layer and mucosal layer were then basted to each other in their new positions, and superficial defect above nostril was covered with a skin graft (after Kazanjian).

expected to take well as long as its width does not exceed about 0.75 cm. Grafts from the rim of the helix, containing a strip of cartilage between the two layers of

1. Kazanjian, V. H.: Plastic Repair of Deformities About the Lower Part of the Nose Resulting from Loss of Tissue, Tr. Am. Acad. Ophth. **42**:338, 1937.

2. Brown, F. B., and Cannon, B.: Composite Free Grafts of Skin and Cartilage from the Ear, Surg., Gynec. & Obst. **82**:253 (March) 1946. Dupertuis, S. M.: Free Ear Lobe Grafts of Skin and Fat, Plast. & Reconstruct. Surg. **1**:135 (Sept.) 1946.

skin, lend themselves particularly well in replacement of the margin of the nostril (Case 4). A wedge of the ear lobe has its usefulness in substituting for circumscribed losses around the nasal tip, columella, and alae (Case 5). Composite grafts are often combined with a larger component of postauricular-skin graft.

The composite graft must be set into a well-vascularized, scar-free bed. If the skin around the defect had already been replaced with a free graft, I preferred to

Fig. 4 (Case 4).—Left, loss of left nostril with extensive scarring adjacent to defect and obliteration of nasal cavity; patient is blind. Center, combination of a composite graft from helix and a full-thickness graft shown at the time of the operation (from Lewin, M. L.: Plast. & Reconstruct. Surg. **5**:432, 1950, by permission of the publisher, Williams & Wilkins Company). Right, graft about two months later with normal patency of nostril.

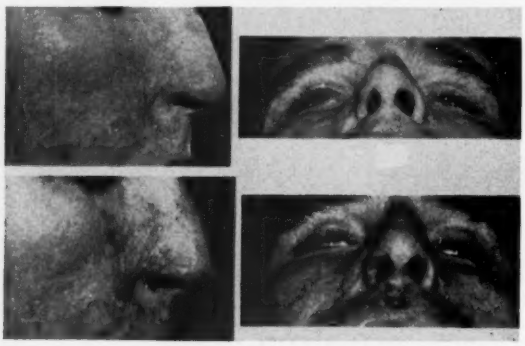

Fig. 5 (Case 5).—Above, retraction and narrowing of right nostril with partial obstruction as a result of burn. Below, widening of nostril by severing it from its base and insertion of wedge-shaped composite graft from ear lobe. Margin of nostril had been previously reconstructed with composite graft from helix. Side of nose had been skin grafted several years earlier. No attempt was made to match the diameter of nostril, since this would require a larger composite graft than was considered safe to use.

delay the composite graft for six months or more. Any scarring around the defect had to be excised. This requirement often transformed a seemingly small defect into a much larger one beyond the scope of a composite graft.

The great advantage of composite grafts is that they permit reconstruction of the defect in a one-stage procedure. They blend well with the surrounding facial

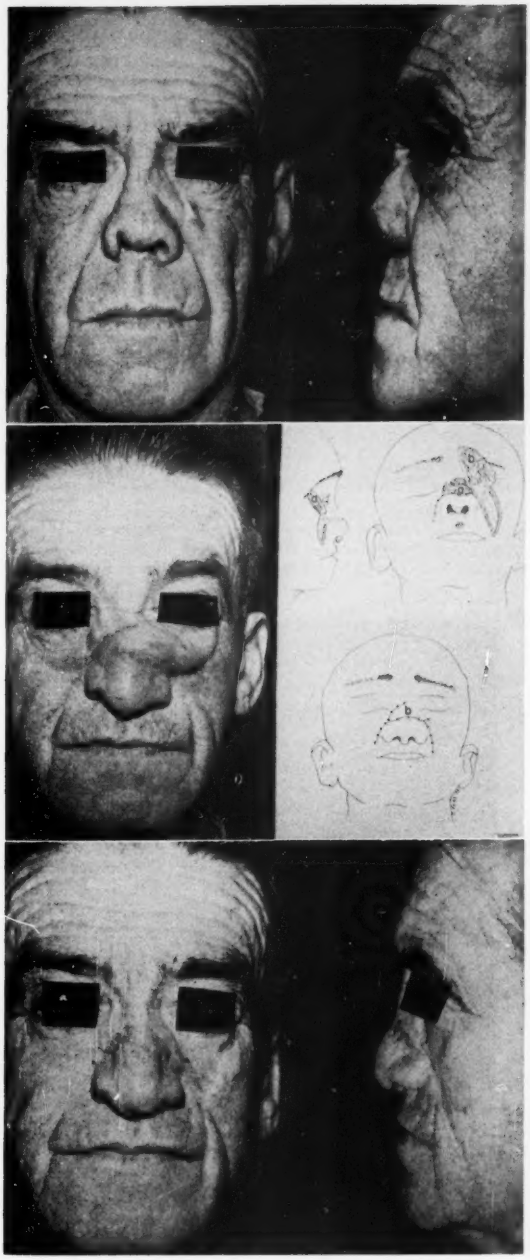

Fig. 6 (Case 6).—Above, syphilitic nasal deformity in man over 50 years; fragment of autogenous cartilage was inserted into nasal bridge 25 years previously with no improvement; note drooping facial skin. Middle, nose lengthened by severing it across in front of pyriform aperture (septum was missing). Defect was reconstructed with two ascending cheek flaps as shown in diagram. Flap *"a"* was turned into nose to serve as lining and flap *"b"* substituted for the outside skin (at left, after first stage, before adjustment of corners of flaps). Below, old cartilage graft removed from nose in first operation was stored in chest wall and later used to support nasal tip. Result achieved in one major and two minor steps. Facial scars of no consequence because of heavily lined face. In 1942 I described another patient with identical deformity but with smooth, hairless facial skin. Neck flap was used for reconstruction, which consisted in seven steps, major and minor (Arch. Otolaryng. **35**:210 [Feb.] 1942).

skin and are free of the excessive bulk which characterizes flap repair. The secondary deformity after an ear-lobe graft is negligible, and the correction of the helix after removal of a composite graft can be done quite satisfactorily.[3]

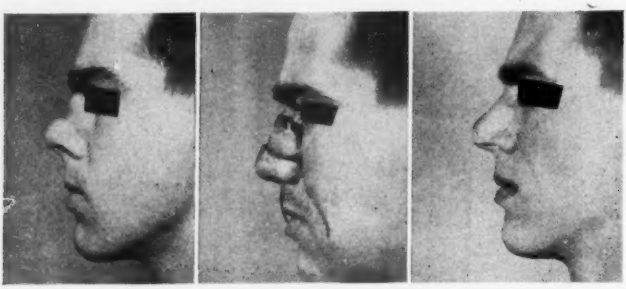

Fig. 7 (Case 7).—Left, defect of nasal dorsum involving loss of skin and supporting structures with severe retraction of nasal tip. Center and right, defect corrected by ascending flap from left nasolabial fold, avoiding the hair-bearing skin. Bulkiness of the flap eliminated depression on nasal dorsum. When seen two years after operation, scar on cheek was practically inconspicuous.

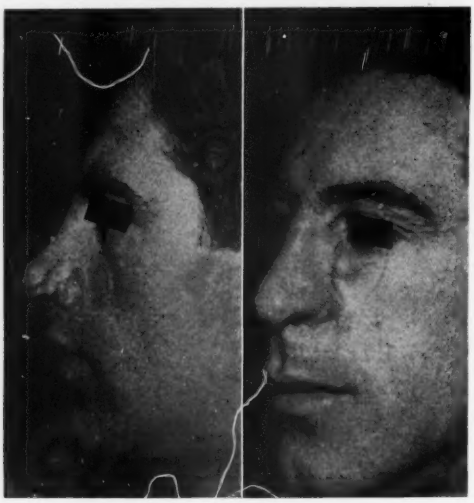

Fig. 8 (Case 8).—Left, defect of left nostril with keloidal plaque of adjacent cheek and lip; retraction of left side of lip. Right, correction by two contiguous flaps from cheek as shown in diagram (Fig. 9). In attempting to minimize facial scarring, nasal flap was made too small, resulting in contracted nostril. The facial scars were not objectionable after a few months, but a better result could have been obtained by other procedures (e. g., vertical forehead flap) whereby more tissue could be available for reconstruction.

CONTIGUOUS FLAPS

Facial flaps from the cheek have limited application in nasal reconstruction. The size of the flap is limited by the area of hair-free skin which can be obtained

3. Lewin, M. L.: Formation of the Helix with a Postauricular Flap, Plast. & Reconstruct. Surg. **5**:432 (May) 1950.

without the need for secondary skin grafting. While the quality of skin lends itself perfectly to nasal reconstruction, the resulting scarring on the face makes it objectionable in most instances, unless it can be made inconspicuous. Contiguous flaps from the cheeks were used primarily in older patients, when it was desirable to accomplish the reconstruction with a minimum of surgery and when the facial scar was of relatively little consequence (Case 6). They were also used in other cases in which I counted on making the secondary scar inconspicuous by placing it along the nasolabial fold (Case 7) or at the junction of the nasal wall (Case 8). This was successfully accomplished in several cases. A thin linear scar properly placed on a man's face is a small price to pay for a nasal flap which blends perfectly with

Fig. 9.—Diagram of reconstruction in Case 8: Flap *a* from nasolabial fold used for resurfacing of the upper lip and base of ala; flap *b* lined with full-thickness graft, used for construction of nostril.

the surrounding tissue. Another advantage of contiguous flaps is that they require very short hospitalization. Some revisions of the flap are often necessary, but they can be performed ambulatorily, and the patient is incapacitated for only a few days.

In connection with the contiguous flap, the vertical forehead flap should be mentioned[4] (Case 9). It has all the advantages of a contiguous flap. It can reach any part of the nose without any preparation. If its width does not exceed 3 cm., the secondary defect can be reduced to a smooth linear forehead scar, quite inconspicuous and not at all objectionable on a man's face. The usefulness of the vertical flap can be increased by lining it so that it can replace part of the nasal wall (Case 10).

4. Kazanjian, V. H.: Repair of Nasal Defects with the Median Forehead Flap, Surg., Gynec. & Obst. **82**:37 (Jan.) 1946.

In women the more involved and more distant sickle flap, which is beyond the scope of this paper, is often preferable. This procedure requires a secondary skin graft, but the latter can be placed close to the hairline and readily concealed.

Other forehead flaps leaving more conspicuous forehead scarring or requiring a skin graft were not used for partial rhinoplasty, except in some cases of post-malignancy defects in which the factors of simplicity and directness of repair outweighed the importance of a satisfactory over-all cosmetic effect.

SUMMARY

Several cases of nasal defects which were corrected by the use of free grafts or contiguous flaps have been presented. These procedures are indicated in selected

Fig. 10.—Above (Case 9), left, defect on dorsum of nose involving skin and supporting structure. Center, direct vertical forehead flap. The bulkiness of the flap eliminated the dorsal depression. Right, final result. Below (Case 10), left, defect of nostril, surrounded by extensive scarring and with loss of supporting structures; vertical forehead flap lined with full-thickness skin graft. Center, flap reaches margin of nostril easily. Right, result after severing of pedicle and adjusting of distal end of flap. Reconstruction required four stages, two of them on an ambulatory basis, with total hospitalization of three days.

cases and offer definite advantages as compared with distant flaps. The limitations of the free composite auricular graft are mainly the size of the defect and the condition of the surrounding tissues. The contiguous skin flaps from the cheeks and forehead can be used for the repair of much larger defects, but the additional local scarring limits their usefulness to a selected group of cases.

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Cases 4, 5, 6, and 8 are from the Surgical Service of the Veterans Administration Hospital, Staten Island, N. Y.

POSTRHINOPLASTIC INTRANASAL ADHESIONS

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RHINOPLASTY is probably the most frequent single operation in the field of plastic surgery. Rhinoplastic literature is full of reports of pleasing end-results, but poor results are rarely reported. Unfortunately, poor end-results are encountered. The most frequent of these is the formation of intranasal adhesions. Adhesions may cause breathing difficulties, but often worse than the breathing difficulties are the nasal deformities produced. Having seen many of these cases and noted how little reference is made to them in the literature, I deemed the subject worthy enough to bring before the Assembly of Plastic Surgeons of Mexico in the hope of producing a profitable discussion. I am sure most physicians have seen such cases and formulated their own methods of repair.

Destruction of some nasal lining, either mucous or skin, will not necessarily produce adhesions unless the exposed granulating surface not only faces another granulating surface but also is forced into direct contact with the other granulating surface. Whenever simple granulating tissue occurs under the nasal bones, little if any discernible external deformity results. In such cases the intranasal denuded area is in time covered by thin fibroepithelial tissue which does not pile up and will not retract or cause any external distortion. If granulating tissue occurs under the nasal cartilages, some deformity may result, depending upon the amount of pull the scar tissue develops and the strength of the cartilage.

Intranasal adhesions bring to the mind of the ear, nose, and throat specialist mainly adhesions between the septum and turbinates. To those physicians interested in rhinoplasty, intranasal adhesions suggest a wider field.

Postrhinoplastic intranasal adhesions may be found anywhere in the nasal cavity but mainly in the nasal vestibule. There they may be found along the margin of the nostril (alar margin) near the medial end. Their presence at that location often causes a local retraction of the alar margin, thus producing a displeasing appearance, especially when the alar margin is compared with the good opposite side. Vestibular adhesions may also be found right under the nasal tip proper, causing a narrowing of the forward part of the nasal vestibule. The narrowing can be so extensive as to be an impediment to breathing and cause distortion of the nasal tip. Cases of vestibular adhesions are met in which almost the entire nasal vestibule is closed with a web-like cicatrix so that a probe can barely be passed along the nasal floor. Combined with a vestibular cicatrix, one often finds an external deformity (a denting in of the lower part of the lateral nasal wall itself or some other irregularity in

Presented before the meeting of the Assembly of Plastic Surgeons of Mexico, Mexico City, November, 1950.

this region). Postrhinoplastic cicatrices also occur along the septocolumella junction, pulling that side of the columella upward and producing another type of unpleasant appearance. Scar tissue may occur in the region of the so-called intercartilaginous line of incision so that a narrowing of the upper part of the nasal vestibule occurs. This not only gives breathing difficulty, but also may cause a

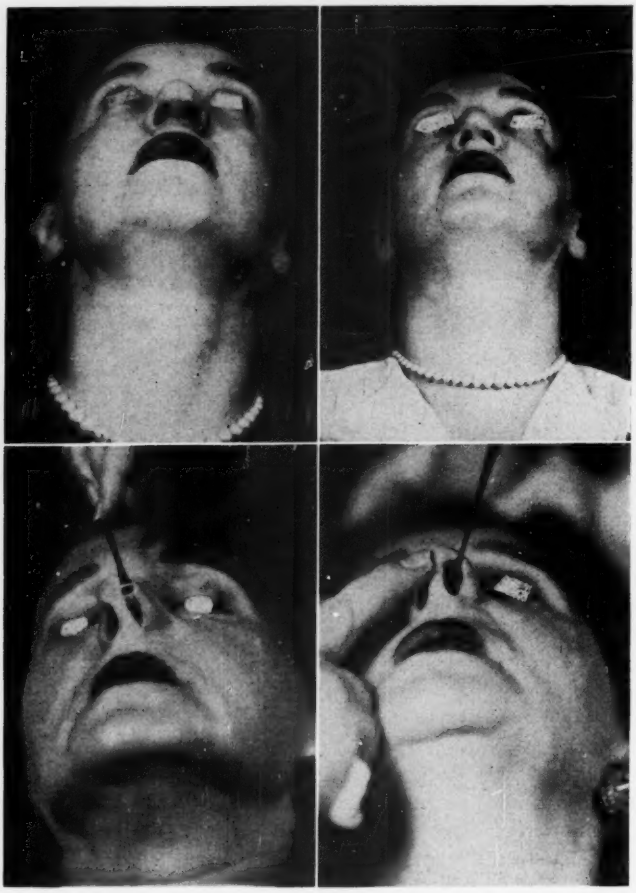

Fig. 1.—On the left is shown the appearance of the nose before the secondary operation; on the right, after the secondary operation.

dent or irregularity on the lateral side of the lower part of the nose. Normally, the nasal vestibule becomes wider as it proceeds backward. In this type of vestibular cicatrix, the vestibule becomes narrow at the constriction and then widens again on proceeding backward, like two funnels approximated to each other by their narrow ends, i. e., wide at the nasal entrance and narrow in the region of the cicatrix and then wide again. This formation produces a real air-current impediment.

Scarring in the nasal vestibule may cause impaired alar mobility which is especially noted on forced inspiratory efforts. In the case of one of my patients, a scar was present below the inferior turbinate. A marked engorgement of the lower end of the inferior turbinate plus an inward tilt of the posterior part of the ala was present. The scar was removed. The mucosa of the inferior turbinate was elevated

Fig. 2.—On the left is shown the appearance of the nose before the secondary operation; on the right, after the secondary operation.

and pulled down, then the alar margin was undermined, grasped, and pulled down, widening the scarred space. A suture was inserted to attach the turbinate mucosa to the lateral skin of the nasal vestibule. A petrolatum-sulfonamide pack was inserted. The turgescence of the end of the inferior turbinate gradually disappeared, with eventual improvement of breathing and lowering of the ala masi. The cause of this scar and alar deformity was that the intercartilaginous incision was made

too high up and too far laterally and was left to granulate instead of being closed by some nearby tissue drawn loosely over the area. Unless we specifically desire an external dimpling or lifting, any exposed area following rhinoplasty should always be covered with some loose nearby tissue.

Surgical operations on the septum, such as submucous resections or other septal corrections, turbinate operations, or electrical or chemical burns, can cause adhesions. Conditions such as ulcerative (purulent) rhinitis, syphilis, and purposeful scars (as induced by the Lautenschlager operation for ozena), rarely seen now, may also produce intranasal adhesions. Improper rhinoplastic procedures, especially corrections around the nasal tip, are the main cause of vestibular adhesions. Congenital types are usually complete or incomplete choanal adhesions and will not be discussed. Adhesions located between the septum and the middle turbinate and between the septum and the inferior turbinate are usually caused by surgical trauma (operations on the nose); adhesions between the septum and outer vestibular wall or anywhere in the nasal vestibule are usually postrhinoplastic.

Postrhinoplastic vestibular adhesions may occur because the cut and exposed tissue of the upper lateral plate at its anterior inferior section becomes adherent to part of the exposed upper margin of the cut columella, to the exposed edge of the lower septal border, or to the exposed and displaced margin of the upper border of the lower lateral plate. In fact, these four structures may even become matted together. Following rhinoplasty, the upper lateral plate is usually left with an exposed margin. When this exposed margin is pressed against another exposed raw area, adherence will occur. The raw areas are pushed toward each other during the postoperative compression stage. Many surgeons do not employ postoperative intranasal packing at all. Proper intranasal postrhinoplastic packing is to me very important as a preventive. If possible, no raw surfaces should be left that can form adhesions. If any are discovered postoperatively, they should be watched, oiled, and even corrected early before the sutures are removed.

The subjective symptoms depend upon whether or not adhesions obstruct the air currents. They may interfere with normal aeration and drainage. Objectively, adhesions can be seen and palpated in the nose. They may be simply bridges between two or more intranasal structures and may not show any symptoms, but often they cause not only nostril blockage but also additional nasal deformity. They are first noted within two weeks after rhinoplasty and become more pronounced later on.

The usual treatment for ordinary simple adhesions advocated in textbooks is to cut through them or bite most of them out and insert a petrolatum gauze packing or splint. This packing is kept in for several weeks. Sometimes a recurrence is prevented; most of the time, however, a recurrence of the adhesions takes place. With this treatment, emphasis for good results is placed on the length of time the intranasal pack or splint is worn. If it is worn less than two weeks, recurrences are almost certain.

In the procedures to be described it is not always necessary to excise the scar. One can sometimes move it to a more desirable area where it will do as little harm as possible, i. e., neither collect secretions nor draw on nearby tissues causing obstruction to breathing nor cause nasal contour distortion. In other words, the scar can be made one of the arms of a Z-plasty and transferred to a harmless area

and the area it occupied before replaced by good skin or mucosa. One of the techniques to be described, therefore, is the Z-plasty principle applied to the intranasal lining in one form or another.

Opposing granulating surfaces noted in the first few days after an intranasal surgical operation or cauterization should be kept apart by petrolatum gauze or other divisive substance (removed only temporarily for cleansing) for several weeks. If feasible, lining tissue should be drawn from nearby and the raw areas covered as early as possible.

It is my experience that in postrhinoplastic adhesions the best results are obtained either soon after the operation or when the scar has matured, that is, when most of its contractility is gone, which may be months after the scar was originally produced. The great difficulty is making the patient wait long enough for this secondary correction.

Intranasal scars may be complicated by extranasal scars with marked distortion of the alar margin, decreased size of the nostril, and also irregularity of the nostril margin. An excellent procedure for these intra-alar and extra-alar scar deformities is the use of a measured composite helix graft obtained from one of the patient's ears. All the scar tissue is removed, and the composite (cartilage and covering) graft is applied and sewed into the new split nostril. A piece of ear lobule can be split and applied, as the case warrants. These procedures are rather drastic, however, and leave a scarred auricle; also, the skin patch is always visible. A procedure for the correction of a mild combined intranasal and external margin scar was to be tried on one of my own patients, but the patient did not go through with the operation. I will present the plan devised.

Many surgeons attempt to correct vestibular adhesions with narrowing of the passages by removing the scar tissues and relining the exposed area with Thiersch's graft. It is to be noted that with this technique, after the adhesions have been removed and the area lined with the graft, a marked improvement is noted immediately after the operation. Later, the Thiersch lining contracts so much that one often wonders if the operation was worth while. This contraction is due to the fact that the Thiersch inlay is only very thin epidermis. What is needed if a graft is to be used, it seems to me, is a graft of greater thickness. Full-thickness tissue will contract very little.

Correction of intranasal adhesions depends on their location and their size. Should the width be too great, so that removal and shifting (sometimes shifting with the scar tissue) is physically impossible, then a Stent auricular skin graft can be inserted.

In correcting intranasal adhesions, preoperative planned procedures should be carried out. No two cases are really alike. Some or all of the fibrous tissue may have to be removed. The mucosa or skin must be cut in such a way as to form flaps in order to cover the raw area. Additional mucosa, if needed, may have to be elevated, preferably septal mucosa. Sometimes it is necessary even to elevate and shift mucosa from a turbinate. Shifting turbinate mucosa is more difficult, and the mucosa is thicker than needed; however, it can be used when necessary. If an adhesion is in contact with a nasal spur and is obstructive to breathing, the nasal spur (or a piece of turbinate) might as well be removed with the adhesion.

The following are some warnings concerning rhinoplasty that seem of great value in avoidance of adhesions and their unpleasant consequences.

1. Unlined space should not be left within the intranasal cartilaginous area. It should be covered by some nearby mucus or skin drawn across the area and sutured without tension with a fine suture.

2. In covering an unlined area in the region of the angle of the lower lateral cartilages, the lateral plate with its skin lining should not be elevated further back. Its lining should be sutured to the lining of the medial plate. If excess skin pedicle lining cannot be obtained, it is better to insert a free skin graft at once.

3. Sections of the lower border of the lateral plate should not be removed to correct a marginal nostril deformity.

4. The cut edges of the upper lateral plates should not be left dangling but should be approximated and sewed to the proper edges of the upper border of the lower lateral plates (always without tension).

Fig. 3.—Procedure for correction of a band between the septum and outer wall.

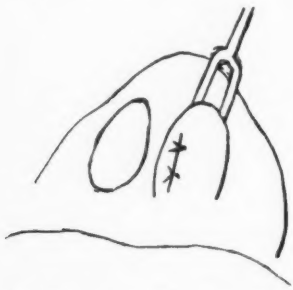

Fig. 4.—Procedure for correction of a scar causing an upward displacement of the columella.

5. Adjustment of the upper lateral plates should be left as the last planned step in the operation. These plates are the main source from which pedicles (mucosa or cartilage and mucosa) can be obtained to fill any unlined areas. They are the "storehouse of repair."

CORRECTIVE PROCEDURES

Adhesive Band Between the Septum and Outer Wall (Fig. 3).—1. The band is completely removed (the white of the septal cartilage is exposed). 2. An incision is made through the septal mucosa down to and through the perichondrium at the upper margin of the scar, not going through the cartilage. 3. The septal mucosa is elevated to and over the perpendicular plate. 4. An incision is made through this flap along its anterior border (nasal dorsum) and another along the posterior border (the floor). 5. The flap is pulled downward and sewed to the lower margin of the septal lining (below the original scar). 6. Sulfonamide-petrolatum packing is inserted. Sutures are removed on the fourth day.

Scar Causing an Upward Displacement of One Side of the Columella (Fig. 4).—1. An anteroposterior incision is made at the upper border of the displaced medial plate. The scar

tissue is removed completely. 2. The septal mucosa is elevated as far as the perpendicular plate (as in the description of the procedure for an adhesive band between the septum and nasal wall). 3. The displaced medial plate with its skin covering is separated from the plate on the opposite side and pulled down until it is even with its mate. One or two mattress sutures are then inserted through both medial plates and skin coverings. 4. The septal mucosa is pulled down and sewed to the skin of the medial plate. If a drag is noted, the septal mucosa is elevated higher before these sutures are inserted. 5. Sulfonamide-petrolatum packing is inserted. 6. The columellar mattress sutures are removed in 48 hours; the columellar septal sutures, at the end of seven days.

Web-Like Cicatrix in the Anterior Part of the Nasal Vestibule (Fig. 5).—The cicatrix may be either a thin web (a bent probe can be hooked behind it), with slight alteration of the alar and columellar walls, or it may be a deep mass of tissues. The latter usually shows a central indentation, and a probe cannot pass behind it.

The thin web is corrected as follows: 1. The web is split in two by an incision along its free margin at *X* and carefully separated, thus producing two flat layers. The flap dissection is

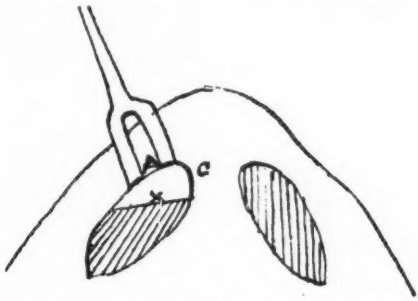

Fig. 5.—Procedure for correction of a web-like cicatrix in the anterior part of the nasal vestibule.

Fig. 6.—Procedure for correction of an adhesive mass in the anterior nasal vestibule (mainly under the nasal tip).

continued down the columella and toward the alar margin. Thus two flaps have been produced, an upper and a lower. 2. The flaps are then incised, the lower flap along its columellar attachment at *C* so that it is left attached at its alar margin, and the deeper (or upper) flap along the alar margin at *A*. The columellar and alar margins are pulled downward so as to equalize them with those on the opposite side. An exposed (raw) area is then found on the columellar and alar margins. 3. The lower flap is folded upward and back to cover any raw alar area. One or two sutures are inserted. The upper, or deeper, flap is folded forward and downward to cover any septocolumellar raw area. Several sutures are inserted. 4. Petrolatum gauze packs are placed in the nostril to keep the flaps in place. 5. The sutures are removed on the fourth day, and the packs are reinserted. These packs are removed every other day, the vestibule cleansed, and the packs reinserted for another two weeks.

Adhesive Mass in the Anterior Nasal Vestibule (Mainly Under the Nasal Tip (Fig. 6).—The mass is seen on elevating the extreme anterior alar margin. It is a matting together of the lower end of the upper lateral plate, a section of the lower septal border, a part of the margin of the lower lateral plate and the upper columellar margin. 1. The superficial epithelial tissue

is elevated, producing a thin epithelial flap. This is split centrally and each part folded to its respective side producing two flaps, a lateral and a medial. 2. The indurated scar tissue is removed. 3. Each structure enmeshed in the scar, i. e., the upper lateral plate, the lower septal mucosa, the upper edge of the columella, and the lower lateral plate, is located and freed. 4. The septal mucosa and perichondrium are elevated as far as necessary. 5. The septal mucosa is cut anteriorly and posteriorly, as in the procedure for an adhesive band between the septum and outer wall. 6. The septal mucosa membrane flap is pulled downward and sewed to the skin flaps of the columella. 7. The lining mucosa of the upper lateral plate is undermined as high as necessary. The alar margin is pulled down to equalize with the margin on the opposite side. The upper lateral mucosa is pulled down and sewed to the exposed upper border of the lower lateral plate. The lateral flap may be used to correct any exposed tissue on the lateral vestibular wall. 8. Sulfonamide-petrolatum packing is inserted. Sutures are removed on the fourth day. The vestibules are repacked, and the total packing is removed on the sixth day.

Alar Dent (One Nostril Larger Than the Other) (Fig. 7).—Scar tissue may be present at either the lower or the upper border of the lower lateral plate or at the lower border of the upper lateral plate. It can pull the nearby alar margin upward, producing a dented alar margin. This is a frequent postrhinoplastic complication and is usually caused by excessive removal of sections of the upper or lower lateral plates and their lining. 1. An intravestibular incision is made parallel to the alar margin, above the alar indentation. The distance from the alar margin depends upon the depth of the indentation (one must visualize rolling the margin down to

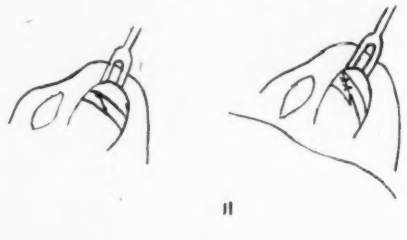

Fig. 7.—Procedure for correction of an alar dent (one nostril larger than the other).

obliterate the dent). The length of this incision must include the entire length of the base of the indentation plus ⅛ in. medially and ⅛ in. laterally. Through this incision the external skin of the nose is elevated over the nasal cartilages to the pyriform bony margin. The lining skin of the alar dent is undermined to the alar margin. With hooks this skin is pulled down so that the indentation becomes a bulge (teat). An unlined vestibular area is then present. 2. An incision paralleling the first is then made about ¼ in. above the first incision. This produces a bipolar flap of the skin lining. 3. The skin lining of this area is separated from the cartilages. 4. The oblong bipolar flap is cut through at an angle, thus producing two flaps. This cut is curved so that when one flap is moved below the other a local bulging of the extreme end will not form. The cut must begin at one end of the base of the indentation and end beyond the other end. One flap is then moved under the other, covering the denuded area. 5. A few sutures are inserted to keep the flaps in place and keep the new alar bulge. This bulge in time flattens out; if not, it can be easily corrected several months later by the removal of small sections of excess lining or by cauterization. (If the unlined area is too large, it is better to cover it with a free postauricular graft.) 6. A sulfonamide-petrolatum pack is inserted. This narrows the nostril somewhat, so that the best results will be obtained if the deformed nostril is also the wider one.

Scar in the Upper Part of the Nasal Vestibule (Along the Intercartilaginous Incision) Causing Marked Narrowing (Funnel-like) (Fig. 8).—In this case an intravestibular Z-plasty gives marked improvement. 1. An incision is made along the scar. Tissues above and below are well undermined and several incisions are made on each side at an angle of 60 degrees. The incisions do not penetrate the cartilage. They produce triangular flaps (an intranasal multiple Z-plasty). 2. The nasal vestibule is stretched, and the triangular flaps are inserted into the

incisions. A few fine sutures are inserted to hold the tissues down. 3. The nostril is packed with sulfonamide-petrolatum gauze. This procedure may be repeated several months later with further improvement.

Combined Intra-Alar and Extra-Alar Scar (Fig. 9).—One case of this kind was seen. The following procedure was planned, but the patient refused further correction. The nasal margin showed a dent and an external scar leading upward from it on the lateral nasal wall. 1. The dotted lines represent the incision only at the alar margin. At the dent this incision splits the scar tissue so that some is part of the external skin and some part of the nasal lining. Through this incision the skin and mucous lining of the nose are elevated to *a* and *b*. The elevation is continued to the anterior margins of the nasal septum and down the septal cartilage (an extra ⅛ to ¼ in.). This will increase the size of the flap. The flap is cut along the septal side and also high up anteroposteriorly (*a*, *b* and *c*). 2. The external skin scar is then removed, thus leaving a triangular space. 3. The lining flap (*a*, *b* and *c*) is pulled down producing a pedicle

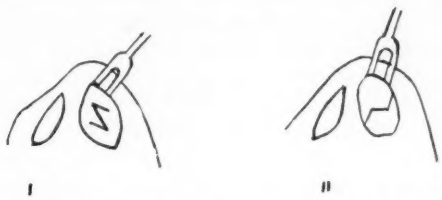

Fig. 8.—Procedure for correction of a scar in the upper part of the nasal vestibule (along the intercartilaginous incision) causing marked narrowing (funnel-like).

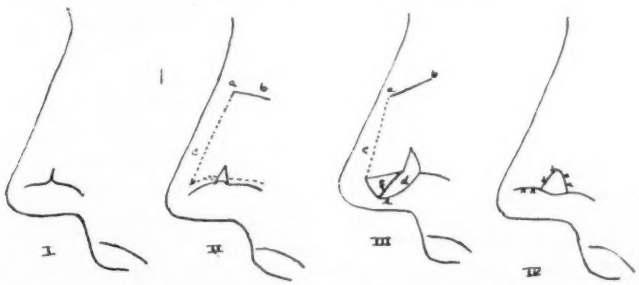

Fig. 9.—Procedure for correction of a combined intra-alar and extra-alar scar.

flap of tissue which protrudes anglewise below the alar margin, *a*, *b*, *c*, *e* and *d*. A nasal speculum is inserted between the lining and outer skin and opened wide so as to enlarge the opening in the skin, thus lengthening the alar margin. The protruding flap is then studied to see how much will be needed to fill in the space in the alar skin. The scar tissue in the flap that will show externally if implanted (and if excessive) (*d*) is removed. 4. The flap (*e* and *d*) is cut at *f* and should have as its alar base sufficient tissue to span the nasoalar space. This pedicle flap (*f*, *e* and *d*) is then turned up and sewed in (it replaced the removed external part of the scar). 5. The remaining section of the protruding nasal lining down to *f* (with the balance of the nasal lining) is pushed back into the nostril and smoothed out against the septal cartilage and lateral nasal wall. The exposed excess is removed. A suture is inserted between the lining and the cut alar margin. The nostril is lightly packed. The unlined space left above the pyriform bony margin will heal over without any scar deformities. An external pressure dressing, in addition to the intranasal packing, is applied. The pressure dressing and sutures are removed in about five days. 6. A slight bulge at the alar margin which has replaced the indentation will in time probably level off. If it does not, it can be corrected several months later.

SUMMARY

I wish to stress that any unlined intranasal areas found after rhinoplasty should be covered with some suitable nearby mucosa or skin loosely drawn in and the edges lightly sutured. If this is not feasible, the area should immediately be covered with a suitable free graft.

A new concept in the surgical treatment of intranasal scarring is proposed. Instead of cutting adhesions and keeping the intranasal walls covered with petrolatum and separated for several weeks (until new modified mucosa develops), I propose the covering of the internal surfaces (after adhesions have been removed or shifted) with strips of nearby skin or mucosa. If that is not feasible, then a free thin postauricular graft should be applied.

Postrhinoplastic intranasal adhesions are always very difficult to correct. It is painful to the patient even with good anesthesia. It is sometimes a good procedure to give a general anesthesia. Good hemostasis, in addition to good anesthesia, is important. These operations require careful saving of all bits of lining. We are dealing in millimeters. It is often very difficult to differentiate between good skin or mucosal lining and scar tissue. So far, my results are not perfect but show great improvement.

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MODIFIED TUNING-FORK TEST THAT CAN BE SUBSTITUTED FOR AUDIOMETER

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I STRONGLY feel that the exact determination of the hearing function should be the otologist's concern and have found that the principle of the percentage scale of hearing in the tuning-fork test hitherto used was illogical from the standpoint of acoustics. Through my experiment I arrived at the conclusion that the usual tuning-fork test should be abandoned for a modified one to which the principle of time difference was applied. What I term the principle of time difference is found by multiplying the damping constant of a tuning fork by the time difference between the hearing period of a deaf person and that of a normal person for the same tuning fork. This matter has already been described by Harvey Fletcher [1] in his book, "Speech and Hearing."

From this principle I have derived a convenient method of measuring the damping constant of a tuning fork, as well as an acoustical instrument for measuring the time difference which is convenient for clinical use. Thus, I can measure hearing losses in decibel scale by the modified tuning-fork test; in other words, I can obtain almost the same audiogram as that obtained by the audiometer.

First I plan to explain that the principle of the percentage scale of hearing in the tuning-fork test hitherto used is illogical from the standpoint of acoustics.

A standard blow of a tuning fork is said to be absolutely necessary for the usual tuning-fork test, although it is technically difficult to give and a standard of intensity has not even been established by any otologist. If a tuning-fork were able to be sounded with a standard blow, the following difficulty in percentage scale of hearing would be encountered. As shown in Figure 1, it is assumed that a tuning fork can be sounded with *I* standard blow which corresponds with the sound intensity of I_1, and its hearing period will be 60 seconds for a deaf patient and 100 seconds for a normal person. In this case the patient's hearing is expressed as 60% hearing, or the hearing loss as 40%. In another case when the same tuning fork is sounded with *II* standard blow which corresponds with the sound intensity of I_2, its hearing period is 30 seconds for the deaf patient and 70 seconds for a normal person. Therefore $30/70 = 43\%$ is obtained as the patient's hearing, i. e., 57% as the hearing loss. For the same deaf patient different values of hearing loss in the former and the latter tests can be derived for the same tuning fork. This is the illogical point in the principle of the percentage scale of the usual tuning-fork test which I desire to point out.

1. Fletcher, H.: Speech and Hearing, New York, D. Van Nostrand Company, Inc., 1929, p. 209.

I consider this inconsistency due to the illogical definition of hearing loss in the usual tuning-fork test. Hearing loss should not be defined as $(1-\frac{t_D}{t_N}) \times 100\%$ but as I_D/I_N because the ratio of t_D/t_N depends upon varied blows of a tuning fork and is not proportional to I_D/I_N. When t_D is the hearing period of a deaf patient and t_N that of a normal person for the same fork, I_D is the threshold intensity of the patient and I_N that of a normal person. Such a discrepancy in the definition of hearing loss between the audiometry and the usual tuning-fork test brings about a discrepancy between the results of the former and the latter.

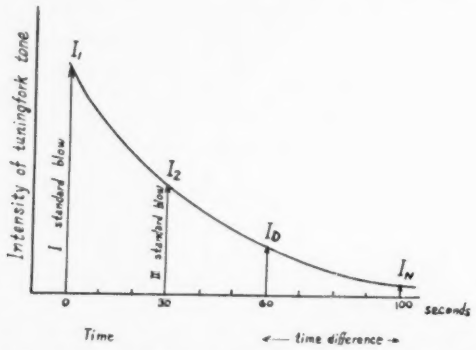

Fig. 1.—I_D stands for the threshold intensity of a deaf patient; I_N for the threshold intensity of a normal person; I_1 for the intensity of a tuning fork at *I* standard blow; I_2 for the intensity of the same tuning fork at *II* standard blow.

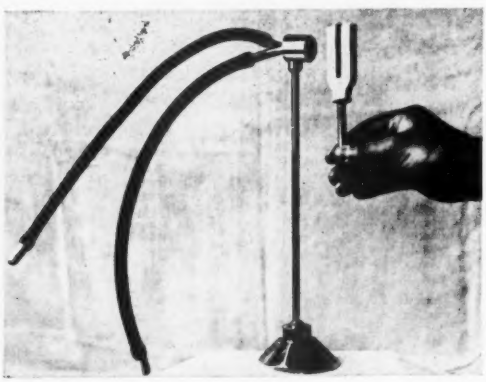

Fig. 2.—Time-difference meter with hard rubber tubes which make the hearing period of fork longer.

From this theoretical consideration it can be realized that Barnard C. Trowbridge's statement [2] that the correlation between audiographic findings and tuning-fork-test results was not consistently demonstrable is a matter of course. On the other hand, when the definition of hearing loss as shown by audiometry is compared

2. Trowbridge, B. C.: Correlation of Hearing Tests, Arch. Otolaryng. **45**:319-334 (March) 1947.

with that as shown by the tuning-fork test, it can be understood that the former is more logical than the latter. Therefore, in the tuning-fork test the definition of hearing loss I_D/I_N must be substituted for t_D/t_N.

In order to do this, it is necessary to find a constant value that is independent of the initial blow of a tuning fork. Such an independent value in a tuning-fork test is the time difference; according to the above-mentioned example, it is seen that the time difference of a tuning fork for a patient and a normal person is consistently 40 seconds, independent of initial amplitudes of the tuning fork, as shown in Figure 1. Consequently the principle of time difference must be applied to the tuning-fork test. According to the principle of time difference described by Harvey Fletcher, hearing loss can be found by multiplying the damping constant of a tuning fork by the time difference, i. e., $\frac{I_D}{I_N} = \Delta\ (t_N - t_D)$.

HOW TO MEASURE THE TIME DIFFERENCE

In order to measure the time difference easily and exactly, I devised an acoustical instrument which is similar to a stethoscope, as shown in Figure 2. However, for the purpose of making the hearing period of a C^5 fork longer, this device, unlike a stethoscope has its resonance at the frequency of C^5. After inserting one ear piece of this device in the subject's ear and another in the examiner's ear, the examiner strikes a tuning fork with a blow of random intensity which creates a sound audible to the subject. When the subject signals that the sound of the tuning fork has just become inaudible to him, the examiner immediately starts the stopwatch and stops it when the sound becomes inaudible to himself. Thus the examiner can obtain the time difference of a tuning fork for the subject.

CONVENIENT CLINICAL METHOD OF MEASURING THE DAMPING CONSTANT OF A TUNING FORK

The examiner measures both his hearing acuity and that of a deaf person by an audiometer at the frequency of a desired tuning fork. Then the damping constant of the tuning fork can be found in decibel per second by dividing the difference of hearing acuity between the two persons by the time difference in seconds. Thus, the damping constants of tuning forks from C to C^5 can be obtained. I compared the damping constants of tuning forks obtained in this way with those obtained by an electroacoustical method and found that there was good agreement.

HOW TO OBTAIN AN AUDIOGRAM OF A DEAF PERSON BY THE MODIFIED TUNING-FORK TEST

The examiner must measure his hearing acuity at various frequencies by an audiometer before the modified tuning-fork test is made. The true hearing loss of the subject is the sum of the examiner's hearing loss as shown by an audiometer plus the hearing loss shown by the modified tuning-fork test for the subject. For example, when the examiner's hearing loss is C=10, C^1=10, C^2=5, C^3=5, C^4=0, C^5=0 db. as shown by an audiometer, the true hearing loss of the subject is as follows: $C = 10 + \Delta c\ (t_{EC} - t_{SC})$, $C^1 = 10 + \Delta c^1\ (t_{EC^1} - t_{SC^1})$, $C^2 = 5 + \Delta c^2\ (t_{EC^2} - t_{SC^2})$, $C^3 = 5 + \Delta c^3\ (t_{EC^3} - t_{SC^3})$, $C^4 = 0 + \Delta c^4\ (t_{EC^4} - t_{SC^4})$, $C^5 = 0 + \Delta c^5\ (t_{EC^5} - t_{SC^5})$ in decibels, when subscripts *E*, *S*, and C stand for the examiner, the subject, and the tuning fork respectively. The time difference according to the

tuning fork of C is represented by $t_{EC} - t_{SC}$, and Δ is the damping constant of the tuning fork. If these values for the patient are plotted on the ordinate and those

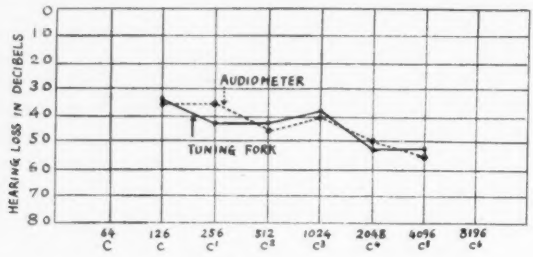

Fig. 3.—Audiogram of K. Y., left ear.

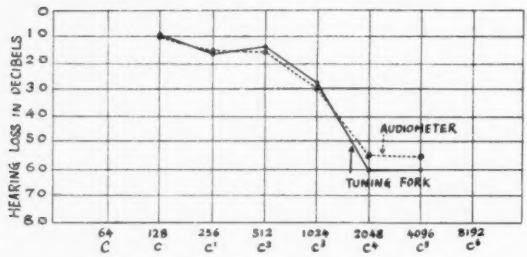

Fig. 4.—Audiogram of S. K., right ear.

TABLE 1.—*The Results of the Modified Tuning-Fork Test and Those of an Audiometer for Patient K. Y., Left Ear*

Tuning Fork	Time Difference Measured	Average, Seconds	Damping Const. Δ DB./Sec.	Hearing Loss by Tuning Fork	Hearing Loss by Audiometer
C	40, 45, 45	43	0.8	34.4	35
C¹	23, 18, 22, 22	21	2.0	42	35
C²	43, 40, 45	42	1.0	42	45
C³	30, 25, 27	27	1.4	37.8	40
C⁴	55, 52, 52	53	1.0	53	50
C⁵	12, 10, 10, 10	10.5	5.0	52.5	55

TABLE 2.—*The Results of the Modified Tuning-Fork Test and Those of an Audiometer for Patient S. K., Right Ear*

Tuning Fork	Time Difference Measured	Average, Seconds	Damping Const. Δ DB./Sec.	Hearing Loss by Tuning Fork	Hearing Loss by Audiometer
C	15, 12,16, 7, 10, 14	12.3	0.8	9.8	10
C¹	8, 9, 8, 8	8	2.0	16.	15
C²	13, 14, 12, 13	13	1.0	13	15
C³	20, 20, 20, 21	20	1.4	28	30
C⁴	60, 58, 61	60	1.0	60	55
C⁵	14, 14, 15, 14	14	5.0	60	55

for the frequencies of the tuning forks on the abscissa, an audiogram of the patient can be obtained which is almost the same as that obtained by an audiometer.

Tables 1 and 2 and Figures 3 and 4 show how closely the results of the modified tuning-fork test coincide with those of an audiometer test for the same patient.

ADVANTAGES OF THE MODIFIED TUNING-FORK TEST

1. For the same patient the results of the modified tuning-fork test can be compared with those of the other hearing tests, such as voice and audiometry, because they are expressed in the decibel scale.

2. The modified tuning-fork test permits a tuning fork to be sounded at an arbitrary intensity above the threshold intensity of a patient, while the usual tuning-fork test does not.

3. The time difference can be measured exactly and easily by the acoustical instrument devised by me when a sounding tuning fork is moved from side to side in front of the mouth of the instrument, because both the subject and the examiner hear a series of interrupted sounds of a tuning fork like the interrupted tones of an audiometer.

4. A tuning fork is simpler and more durable for clinical use than an audiometer.

MY EXPERIENCE WITH THE DAMPING CONSTANT

From my experience I found that the value of the damping constant, when the center of gravity of a tuning fork coincided with the center of its symmetry, was not much varied by different holdings of a tuning fork, while other authors, Kluge and Reisig and Hunter [3] reported a great variation in the damping constant due to the different holdings. In order to avoid such an error, the end of the stem of a tuning fork must be held loosely in the hand in the test as well as in the measurement of the damping constant.

PHYSICAL QUALITY OF THE TUNING FORK

An important physical quality of a tuning fork used in the clinic is its damping of vibration. Therefore it is necessary to learn the vibratory mechanism of a tuning fork and to understand the principle of the modified tuning-fork test, including the damping mechanism.

M = the mass of a prong set in vibration

R = the viscous friction of a prong which is mainly due to internal molecular friction of metal in vibration

S = the stiffness of a prong

X = the displacement of a prong

T = time

In analyzing the vibratory force of a tuning fork, it can be recognized that the inertia force of a prong is in balance with its spring and frictional forces. The inertia force acting on a prong set in vibration is expressed by multiplying the mass by the vibratory acceleration of a prong, i. e., $M \frac{d^2X}{dT^2}$. Some part of the inertia force dissipated in friction is found by multiplying the friction by the virbratory velocity of a prong, i. e., $R \frac{dX}{dT}$. The spring force acting against the displacement of a prong is expressed by SX. If the direction of the displacement is taken as

3. Hunter, R. J.: Tuning Fork Tests Reported in Terms of Decibels, Tr. Am. Otol. Soc. **28**:141-153, 1938; Laryngoscope **48**:560-571 (Aug.) 1938.

positive, the acting direction of SX and $R\frac{dX}{dT}$ is negative. Therefore, the following equation is obtained showing the forces in equilibrium.

$$M\frac{d^2X}{dT^2} = -R\frac{dX}{dT} - SX$$

Integrating for T, the answer is obtained for X, i. e., the vibratory behavior of a tuning fork.

$$X = Ae^{-\frac{RT}{2M}}\cos\left(\sqrt{\frac{S}{M} - \frac{R^2}{4M^2}}\,T + \Theta\right)$$

A is an arbitrary constant of integration and Θ a phase constant consisting of M, R, and S. $\mathrm{Cos}(WT + \Theta)$ is a sinusoidal vibration because $\sqrt{\frac{S}{M} - \frac{R^2}{4M^2}} = W$ is a constant showing the natural circular frequency of a tuning fork, and only T is a variable. The important term for our tuning-fork test is $Ae^{-\frac{R}{2M}T}$ in which A is the initial amplitude of a tuning fork and e is the base of natural logarithm. Damping is expressed by $e^{-\frac{R}{2M}T} = \frac{1}{e^{\frac{R}{2M}T}}$. Therefore the threshold intensity of a deaf person is in proportion to $A^2e^{-\frac{R}{M}t_D}$, while that of a normal person to $A^2e^{-\frac{R}{M}t_N}$. The hearing loss of a deaf person is $\frac{A^2e^{-\frac{R}{M}t_D}}{A^2e^{-\frac{R}{M}t_N}} = e^{\frac{R}{M}(t_N - t_D)}$. Representing this value in decibel scale, the following equation is finally obtained:

$$\text{Hearing loss} = 10 \times \frac{R}{M}\,(t_N - t_D)\log_{10} e = \Delta\,(t_N - t_D)\ \text{db.}$$

when $\Delta = 10\frac{R}{M}\log_{10} e$ is the damping constant of a tuning fork.

RELATION BETWEEN VOICE TEST AND MODIFIED TUNING-FORK TEST

The definition of hearing loss in voice tests is represented by D_N/D_D when D_N is the hearing distance of a normal person from a sound source and D_D is that of a deaf person. This principle is easily reduced to the decibel scale as follows:

$$\text{Hearing loss} = \frac{I_D}{I_N} = \frac{D^2_N}{D^2_D} = 20\log\frac{D_N}{D_D}\ \text{db.}$$

Therefore it can be realized that the results of a voice test can be compared to those of both the modified tuning-fork test and audiometry. On the contrary, the principle of the usual tuning-fork test $\left(1\frac{t_D}{t_N}\right) \times 100$ is not proportional to I_D/I_D; in other words, it is not comparable to the other tests. Thus it can be understood that both the modified tuning-fork test and the voice test are logical from the standpoint of acoustics, while the tuning-fork test hitherto used is not so.

SUMMARY

From the standpoint of acoustics it can be understood that the tuning-fork test with the time difference is logical, while the tuning-fork test hitherto used is not so. Therefore, the former must be adopted and the latter abandoned. Through experiments the results of the modified tuning-fork test can be found to be in good agreement with those of the audiometer, i. e., the modified test can be substituted for the audiometer.

Tairamachi 186, Meguroku.

CONTRIBUTIONS OF AUDIOLOGY TO FENESTRATION SURGERY

Including a Formula for the Precise Prediction of the Hearing Result

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AND
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AUDIOLOGY is a new word coined in 1945 at approximately the same moment by Canfield of Yale University [1] and Carhart of Northwestern University. It is defined as "the science of hearing," and an audiologist, as the term is generally used in the United States, is a physician who has pursued graduate studies in hearing and whose main interest is in the evaluative and rehabilitative aspects of hearing problems.

The first department of audiology in a university was established in 1946, when the older Department of Speech Reeducation of the School of Speech at Northwestern University was renamed the "Department of Speech Correction and Audiology." The addition of the name "audiology" signified the broadening interest in the mechanics of sound and hearing as a vital factor in the development and use of speech.

In 1947 the Department of Speech and Audiology of the School of Speech joined with the Department of Otolaryngology of the Medical School in a diagnostic hearing clinic. This merging of two closely related fields in a hearing clinic has been an exceedingly happy and stimulating experience for both the otologists and the audiologists. It has begun to yield some very interesting and useful concepts applicable to fenestration surgery. It has been seen that audiology is enabling the otologist to place greater confidence in his audiometric test results in patients with otosclerosis, particularly in bone-conduction audiograms. Audiology is pointing the way toward the recognition of the rather unusual but very interesting patient with a psychogenic hearing loss superimposed on an otosclerotic hearing loss, and it has provided definite objective measurements for the hearing performance of a fenestrated ear contrasted with that of a hearing-aid-aided ear. Such a comparison is of more than academic interest, for in a very real sense the fenestration operation and the hearing aid are in competition: the same patient whose hearing difficulty is ideally suited for fenestration is also an ideal hearing-aid candidate. Finally, and perhaps of the greatest interest and value to fenestration surgery, audiology is

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The Herbert Birkett Memorial Lecture delivered by George E. Shambaugh at Montreal, Canada, March, 1951.

1. Canfield, N.: Audiology; the Science of Hearing, Springfield, Ill., Charles C Thomas, Publisher, 1949.

leading the way toward a clearer conception of the mechanics of the fenestrated ear from which a formula has been evolved for predicting the precise hearing result that a particular patient may anticipate from a successful fenestration operation. This formula defines more sharply the indications for fenestration and should result in the elimination of an appreciable number of immediate failures from surgery.

PURE-TONE AUDIOMETRY IN CLINICAL OTOSCLEROSIS

Otologists have learned to place great reliance on the pure-tone air-conduction audiogram, provided a few simple precautions are observed in testing:

1. The audiometer must be in good working order and properly calibrated, a good working rule being that the average threshold for 10 normal adult ears should be within 5 db. of the 0 line. The calibration should be rechecked at regular intervals, and if it is off the instrument should be returned to the manufacturer for recalibration.

2. The proper testing technique must be used, namely the ascending technique, the threshold being the first intensity consistently heard coming from inaudibility to audibility, with constant use of the tone interruptor. We emphasize this rather rudimentary but fundamental technique of audiometry, for some otologists still employ the less accurate descending technique with a continuous tone, despite the recommendation of the committee on the conservation of hearing of the American Academy of Ophthalmology and Otolaryngology that the ascending technique with interrupted tone be used.[2]

In contrast to the confidence placed in the air-conduction audiogram, otologists have tended to mistrust the bone-conduction audiogram as a reliable measure of cochlear nerve reserve, while acknowledging that it is almost the only good measure that is available. Audiology has helped to dispel this mistrust with the recent demonstration that, provided certain precautions are observed, bone-conduction audiometry is statistically exactly as consistent as air-conduction audiometry.[3] These precautions must be emphasized, for failure to observe them accounts, in part at least, for the widespread mistrust in the bone-conduction audiogram. The precautions for consistent bone-conduction audiometry are the same as for consistent air-conduction tests, with these four important differences:

1. Mechanical defects in the bone oscillator occur oftener than in the air receiver, necessitating constant checking of the bone-conduction unit. The otologist can do this by checking all bone-conduction audiograms with the tuning-fork tests, and, when there is an obvious discrepancy, the calibration of the bone-conduction unit is rechecked. (Information on calibration of the bone-conduction receiver is given in paragraph 3.) Another method is by noting the air-conduction and bone-conduction curves in patients with pure perceptive hearing losses.

2. Masking is required in all bone-conduction audiometry, for not more than 10 db. is lost passing through the skull from one mastoid to the other, whereas in air-conduction audiometry masking is needed only when the hearing in the two ears differs by more than 30 db. The difficulty lies in the fact that too loud masking

2. Hughson, W., and Westlake, H.: Manual for Program Outline for Rehabilitation of Aural Casualties Both Military and Civilian, Tr. Am. Acad. Ophth., Supp., pp. 1-15 (Jan.) 1944.

3. Carhart, R., and Hayes, C.: Clinical Reliability of Bone-Conduction Audiometry, Laryngoscope **59**:1084-1101, 1949.

alters the bone-conduction threshold (in some patients more than in others), while too little masking will fail to exclude the opposite ear.[4] Correct optimum masking for bone-conduction audiometry requires an unusually alert and sophisticated audiometrist.

3. The bone unit must be properly calibrated. This has been a serious stumbling block, partly because the manufacturers have had difficulty in standardizing proper calibration for the bone receiver so that one make of audiometer would give a bone-conduction threshold of 20 to 30 db. higher or lower than another instrument. At the present time it is necessary for the otologist to calibrate his own audiometer for bone. One difficulty in doing this with normal ears is that few test rooms are completely soundproof and the residual noise interferes with the bone-conduction threshold. To eliminate this source of error, Carhart has suggested that the bone-conduction unit be calibrated with 10 ears with perceptive hearing losses of moderate degree.[5] Assuming that the losses by air and by bone will be exactly equal in a per-

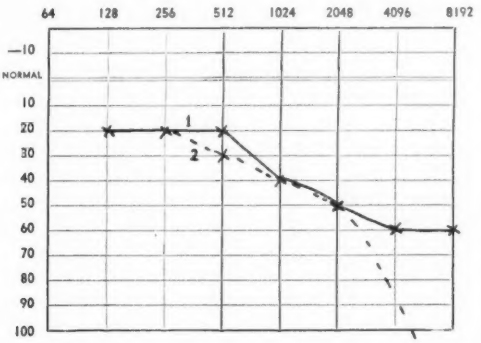

Chart 1.—Patient with a pure perceptive loss (presbycusis) showing "interweaving" of air-conduction and bone-conduction curves indicating correct calibration of the bone-conduction unit. Line 1 shows air conduction and Line 2 bone conduction.

son with pure perceptive deafness (Chart 1), the average loss by bone for these 10 ears should exactly equal the average loss by air for each frequency. If not, a "correction factor" equal to the discrepancy should be applied to all bone-conduction audiograms made on the instrument.

4. A very quiet soundproofed test room is more important for good bone-conduction audiometry than for air-conduction tests, inasmuch as air-conduction tests are done with both ears covered, affording considerable protection against outside ambient noise, whereas bone-conduction tests are done with the ears uncovered, since occluding the meatus alters the bone-conduction threshold except in the presence of severe conductive hearing losses.

Having taken the precautions to insure consistency in air-conduction and bone-conduction audiometry, we can make the following interesting observations in clinical otosclerosis.

4. Cochran, M.: Masking in Audiometry, Thesis, Northwestern University, 1946.

5. Carhart, R.: Clinical Application of Bone-Conduction Audiometry, Arch. Otolaryng. **51**:798-807 (June) 1950.

Air-Conduction Curve.—The transmission of sound through any vibrating system varies with the stiffness, mass, and friction of the system. Johansen [6] has combined these three factors in an impedance formula for the sound-conducting apparatus of the middle ear. According to Johansen's formula, the hearing for low tones is chiefly impaired when the stiffness factor is increased, but if the mass factor is increased the hearing for high tones will be more greatly impaired. P. Campbell,[7] applying this formula to otosclerosis, suggests that the earliest effect of stapes fixa-

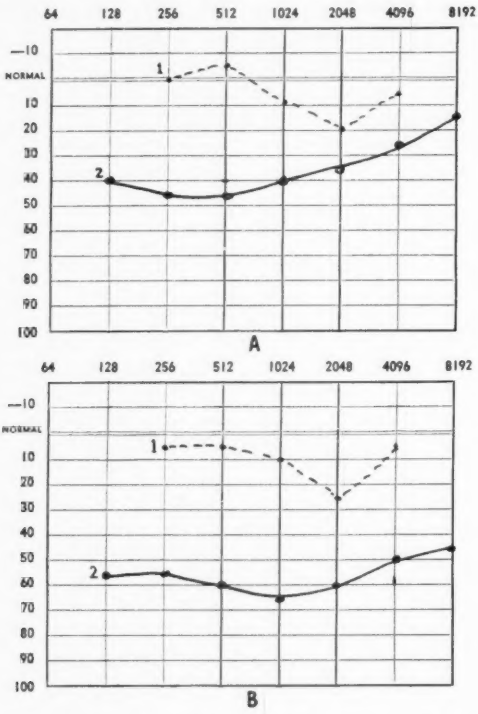

Chart 2.—Lines 1 show bone conduction and Lines 2 air conduction. *A*, early otosclerotic stapes fixation showing "stiffness tilt" in air-conduction curve. The Carhart notch can be noted in the bone-conduction curve. *B*, complete stapes ankylosis showing "mass flattening" in air-conduction curve. The Carhart notch can be noted in the bone-conduction curve.

tion is to increase the stiffness of the sound-conducting system, with a theoretical tilt in the air curve downward toward the low tones (Chart 2*A*). This may be termed the "stiffness tilt of partial stapes fixation." As the ankylosis becomes complete and the stapes footplate becomes, in effect, part of the labyrinthine capsule,

6. Johansen, H.: Relation of Audiograms to the Impedance Formula, Acta oto-laryng., Supp. 74, pp. 65-75, 1948.

7. Campbell, P. A.: The Importance of the Impedance Formula in the Interpretation of Audiograms, Tr. Am. Acad. Ophth. **54**:245-252, 1950.

the mass of the capsule is added, with a theoretical greater loss for high frequencies and a flattening of the audiogram (Chart 2*B*). This may be called the "mass flattening" of complete stapes ankylosis.

Bone-Conduction Curve.—Until very recently otologists assumed that until there was cochlear-nerve involvement the bone-conducted hearing in otosclerosis remained unimpaired. Juers [8] was the first to point out a surprising but fairly consistent improvement in bone-conducted hearing following fenestration, greatest for the frequencies 1024 and 2048. Since it is illogical to believe that fenestration could restore or improve a degenerated nerve, Carhart suggested that in stapedial ankylosis there is a mechanical effect on bone-conducted hearing, perhaps of the nature

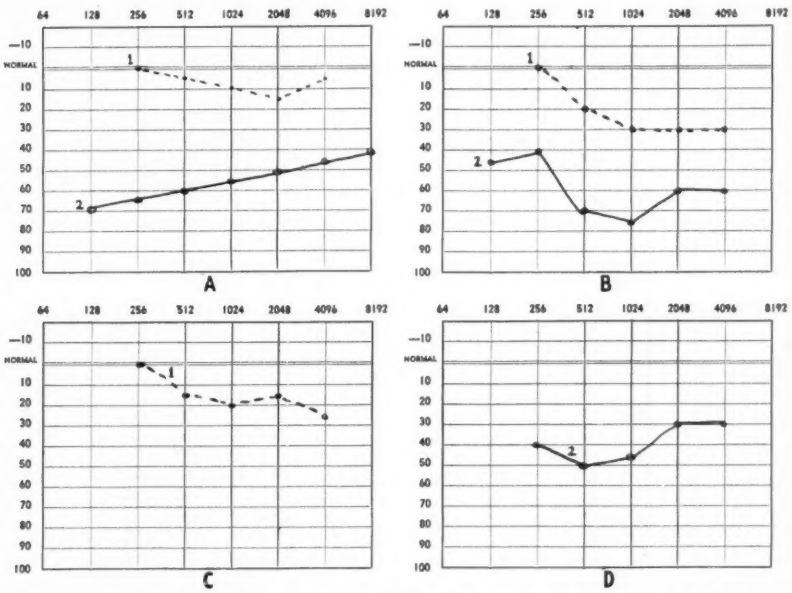

Chart 3.—Lines 1 show bone conduction and Lines 2 air conduction. *A*, average air-conduction and bone-conduction curves of maximum stapes ankylosis uncomplicated by cochlear-nerve degeneration, showing the Carhart notch in the bone-conduction curve. *B*, otosclerotic stapes fixation with cochlear-nerve degeneration, showing perceptive and conductive components.

of a phase-interference phenomenon, which is largely removed by fenestration.[5] This mechanical effect produces a characteristic notching in the bone-conduction audiogram, deepest at the frequency 2048 but including 512 through 4096. The depth of this "Carhart notch" in the bone-conduction audiogram of otosclerosis varies somewhat (perhaps with anatomical differences between ears), but it averages about 5 db. for the frequency 512, 10 db. for 1024, 15 db. for 2048, and 5 db. for 4096 (Chart 3*A*). The true cochlear reserve of a patient with otosclerosis requires a correction of the bone-conduction curve for this mechanical notch, a reasonable

8. Juers, A. L.: Observations on Bone-Conduction in Fenestration Cases, Ann. Otol. Rhin. & Laryng. **57**:28-40, 1948.

correction being the addition of 5 db. to the frequency 512, 10 db. to 1024, 15 db. to 2048, and 5 db. to 4096.

Having corrected the bone-conduction audiogram of the patient with otosclerosis for the otosclerotic notch, we may (1) take the corrected bone-conduction curve as the most reasonable estimate of the perceptive component of the hearing loss (Chart 3*B*, *C*, and *D*) and (2) take the air-bone-conduction gap (after correction for the notch) as the most reasonable estimate of the conductive component of the hearing loss.

We have observed at operation that when the air-bone-conduction gap is less than 35 or 40 db. the stapes is only partially fixed and when palpated with a probe is still slightly movable; but when the air-bone-conduction gap is 55 to 65 db. the stapes when palpated is invariably found to be as solidly immovable as a rock. The greatest possible air-bone-conduction gap of complete stapes fixation appears to be around 55 to 65 db. for the speech frequencies (it may be a little greater for the frequencies 128 and 256 and a little less for the frequencies 2048 and 4096). Thus, the maximum loss of a pure stapes ankylosis without cochlear involvement is an average loss of 65 db. for the three speech frequencies. When there is a greater loss there is always an added factor, either cochlear degeneration or psychogenic component, and in either of these the bone-conducted hearing is impaired so that the air-bone-conduction gap never exceeds the 65-db. average for the three speech frequencies.

SPEECH AUDIOMETRY IN CLINICAL OTOSCLEROSIS

From time to time the fenestration surgeon has been disturbed by doubts as to the validity of pure-tone audiometry as a measure of ability to hear the human voice. Audiology has provided the otologist with two practical and useful measures for the ability to hear and understand speech. One is the "speech-reception threshold." This is determined by presenting to the patient, one ear at a time through earphones or both ears at once in a free field, common two-syllable words of equal accent called "spondaic words," such as "baseball" or "workshop." The decibel intensity at which the patient repeats correctly 50% of these spondaic words in his "SR," or speech-reception threshold. It is very interesting—and reassuring—to learn that clinical experience demonstrates an extremely close correlation between the speech-reception threshold and the average pure-tone threshold for the frequencies 512, 1024, and 2048.[9] This correlation is particularly consistent in the patient with otosclerosis, permitting the fenestration surgeon to use the average pure-tone loss for the speech frequencies as an accurate measure of the otosclerotic patient's speech threshold. One of the exceptions to this rule is the patient with a psychogenic loss superimposed on a clinical otosclerosis, in whom a manifest discrepancy between the pure-tone loss and the speech-reception threshold calls attention to the possibility of a "psychogenic overlay." In this patient hearing in the unfenestrated ear is improved along with that in the fenestrated ear (Chart 4*A* and *B*), a phenomenon seen rather infrequently in our experience but one that has given rise to certain confusion and some bizarre theories of a "crossed hearing reflex." A psychogenic component superimposed on an otosclerotic hearing loss also probably accounts for

9. Carhart, R.: Monitored Live-Voice as a Test of Auditory Acuity, J. Acoust. Soc. Am. **17**:339-349, 1946; Individual Differences in Hearing for Speech, Ann. Otol. Rhin. & Laryng. **55**:233-267, 1946.

the occasional patient who experiences a phenomenal hearing gain of 50, 60, or 100 db. from fenestration—gains that are entirely inconsistent with the improvements usually received from this operation (Chart 4*C* and *D*).

The second test for the hearing of speech is the "discrimination test," which is particularly useful in pointing toward factors other than a pure conductive loss. A certain type of patient may have a fairly good speech-reception threshold for spondees, but they have difficulty in discriminating between words with more difficult phonetic sounds. The Harvard lists of phonetically balanced words, known as the "PB lists," are composed of words selected to include in their proper proportion the different phonetic sounds in the language. One type of discrimination test

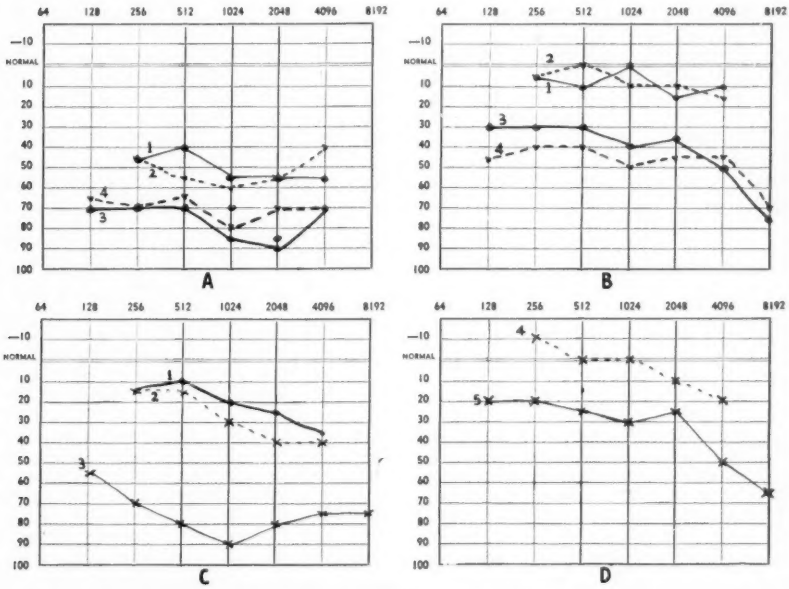

Chart 4.—*A* and *B*, otosclerotic stapes fixation with psychogenic overlay. Preoperative air-conduction loss of 82 db. in right ear contrasted with a speech-reception threshold of 54 db. in that ear. Fenestration and removal of the psychogenic component by surgery resulted in not only the unusual gain for the fenestrated ear of 48 db. but also a gain for the unfenestrated ear of 28 db. Gain for bone conduction as well as for air conduction after surgery can be noted. Line 1 shows bone conduction in right ear, Line 2 bone conduction in left ear, Line 3 air conduction in right ear, and Line 4 air conduction in left ear. *C* and *D*, patient with an unusually large gain of 58 db. from fenestration, with a simultaneous gain in bone conduction that indicates a psychogenic overlay (of about 20 db.). Line 1 shows corrected bone conduction, Line 2 bone conduction, Line 3 air conduction, Line 4 postoperative bone conduction (gain of 25 db.), and Line 5 postoperative air conduction (gain of 58 db.).

(the one we use) consists in presenting to the patient at a constant intensity 25 db. above his speech-reception threshold the phonetically balanced list of words, and the percentage that he repeats correctly in his "discrimination score."

The normal-hearing person and the patient with a pure conductive loss will show a high discrimination score (90 to 100% according to our test results). When the discrimination score is impaired, it is evidence of a factor other than a

pure conductive loss; in cases of otosclerosis it usually means cochlear-nerve degeneration. The discrimination test is thus a useful adjunct to pure-tone bone-conduction audiometry in selecting a patient for fenestration, because a low score suggests the presence of cochlear-nerve degeneration.

COMPARISON OF FENESTRATED EAR WITH HEARING-AID-AIDED EAR

The two commonly used speech tests, that is the speech-reception threshold and the discrimination test, give us useful objective tools for measuring the performance of the fenestrated ear as compared with that of the hearing-aid-aided ear in hearing and understanding speech. To make this comparison the following method is used for administering the tests.

Preoperatively the speech-reception threshold and the discrimination score are obtained in a free field while the patient wears his hearing aid at "use setting." The "use setting" is the volume setting which the patient has found

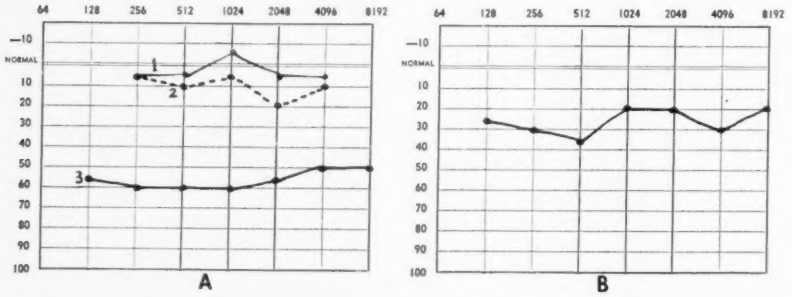

Chart 5.—Patient with "A" suitability with better hearing three months after fenestration than with hearing aid (Western Electric Audiphone), worn for three years before operation. *A*, preoperative speech reception with hearing aid was 25 db. and discrimination 92%. Line 1 shows corrected bone conduction, Line 2 bone conduction, and Line 3 air conduction. *B*, postoperative speech reception without hearing aid was 24 db. and discrimination 100%.

from day to day practical experience is the most comfortable and useful for his needs. This volume is usually below the maximum amplification of the instrument and also below the comfort volume when tested in a soundproof room, for the modern hearing aid has reserve power which is rarely needed and indeed cannot be tolerated by the average patient with otosclerosis in the usual noisy environment of everyday living. Accordingly, to make a fair comparison between an ear aided by a hearing-aid and a fenestrated ear, it is essential that the hearing aid be tested at the patient's "use setting." Three to six months after operation when the hearing begins to become stabilized at the level of the postoperative result, the patient is again tested in a free field for his speech-reception threshold and his discrimination score. When the postoperative fenestrated ear is compared with the preoperative hearing-aid-aided ear, certain interesting conclusions can be drawn.

In "A" patients,[10] ideally suited for fenestration because the (corrected) bone-conducted hearing for the speech frequencies is within the normal range, the per-

10. Juers, A. L., and Shambaugh, G. E., Jr.: Indications for and End Results of Fenestration Surgery, Ann. Otol. Rhin. & Laryng. **57**:397-405, 1948.

formance of the fenestrated ear is, on the average, slightly superior to the performance of the ear with the hearing aid that was worn before the operation both in volume (speech reception threshold) and in clarity (discrimination score) (Chart 5). It must be emphasized that this was the average result in 16 consecutive "A" patients six months after operation (Table 1) and that in some cases the

TABLE 1.—*Average Performance of Fenestrated Ear Contrasted with Hearing-Aid-Aided Ear in Thirty Consecutive Patients*

	Before Fenestration (With Aid)		After Fenestration (Without Aid)	
	S. R. Threshold*	P. B. Score†	S. R. Threshold	P. B. Score
16 "A" patients	27.2 db.	94.7%	26.9 db.	94.9%
6 "B" patients	30.9 db.	87.4%	36.2 db.	91.5%
8 "C" patients	38.2 db.	83.4%	44.5 db.	89.1%

* S. R. stands for speech reception.
† P. B. stands for discrimination.

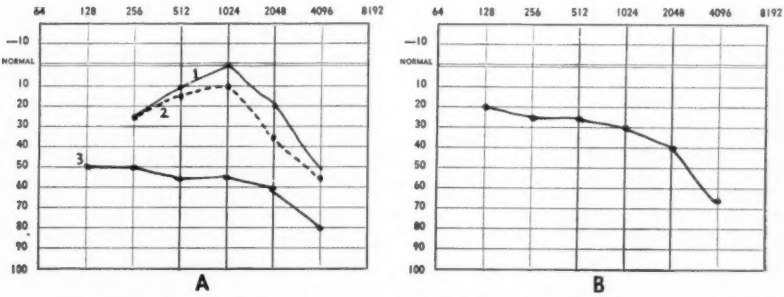

Chart 6.—Patient with "B" suitability whose hearing after fenestration surpassed hearing with a hearing aid (Paravox), worn for two and one-half years before operation. *A*, preoperative speech reception with hearing aid was 35 db. and discrimination 88%. Line 1 shows corrected bone conduction, Line 2 bone conduction, and Line 3 air conduction. *B*, postoperative speech reception was 30 db. and discrimination 98%.

fenestrated ear did not perform as well as the ear with the hearing aid before operation. Another point that should be brought out is that when the patient is in a situation requiring more acute hearing he cannot turn up his fenestrated ear as he could his hearing aid, and therefore he may be somewhat handicapped in certain situations.

In "B" patients, with less ideal suitability on account of the beginning of nerve degeneration for the frequency 2048, as revealed by bone-conducted hearing below the normal range (after correction for the Carhart otosclerotic notch), the performance of the fenestrated ear is on the average definitely inferior to the performance of the ear with the hearing aid in volume (speech-reception threshold) but slightly superior in clarity (discrimination score). Again we are speaking of averages, for individual "B" patients may surpass with their fenestrated ear the hearing obtained with their hearing-aid-aided ear both in volume and in clarity (Chart 6).

In "C" patients, with borderline suitability, the average result following fenestration is again inferior to the result with a hearing aid in volume but slightly superior in clarity.

Thus we can say, on the basis of the measurements made thus far, that in the "A" patients with pure otosclerotic stapes ankylosis (without cochlear involvement), fenestration is the rehabilitative procedure of choice, provided the patient knows and accepts the definite possibility of immediate failure due to technical errors or to serous labyrinthitis or later failure due to osteogenic closure. In "B" and "C" patients with otosclerosis complicated by early cochlear-nerve degeneration, a hearing aid will give on the average greater volume of hearing but slightly poorer clarity than fenestration. The decision for or against surgery in each case will depend upon the age of the patient, his particular hearing needs, and the possible protective effect of fenestration on further cochlear-nerve degeneration.[11] As a general rule, continued hearing-aid use is advised in older persons with some cochlear involvement, while fenestration should be considered in younger persons with slight cochlear degeneration provided the definite limitations of fenestration are clearly understood and accepted.

MECHANICS OF THE FENESTRATED EAR

The exact purpose of the ossicular chain was not clearly understood until comparatively recently, when two important functions were demonstrated. One is to protect the cochlea against the injurious effects of excessive noise by means of the reflex contraction of the intratympanic muscles.[12] The other is to overcome the sound barrier between air and liquid by means of a lever mechanism to convert air vibrations of small force and large amplitude into fluid vibrations of large force and small amplitude. This "impedance matching" mechanism consists of the large tympanic membrane, the ossicular chain, and the small oval window. It has been shown on the experimental animals, as well as by mathematical calculation, that the ear loses 20 to 30 db. of hearing when it is deprived of this lever mechanism.[13] Inasmuch as the fenestrated ear possesses a new sound pathway but one without a lever-impedance matching mechanism, we should expect, theoretically, a residue of unrestored conductive loss of 20 to 30 db. after a successful fenestration. This important and interesting idea originated with Davis and Walsh at Washington University,[14] who emphasized that 20 db. of hearing loss is the upper limit, or ceiling, of hearing that can be attained by fenestration. Shambaugh,[15] on the other hand, has selected 25 db. as the *average* residue of conductive hearing loss remaining after fenestration. This corresponds closely to the results of experiments by Bekesy,[16] who found a twentyfold pressure transformation between the tympanic membrane and the stapes equaling a gain of 26 db. Our experience has indicated

11. Shambaugh, G. E., Jr.: Effect of Fenestration Operation on Nerve Degeneration of Otosclerosis, Tr. Am. Acad. Ophth., Supp., pp. 42-46 (Nov.-Dec.) 1949.

12. Kobrak, H. G.: Zur Physiologie der Binnenmuskeln des Ohres, Beitr. Anat., Physiol., Path. u. Therap. Ohres **28**:138-160 (May) 1930.

13. Kostelijk, P. J.: Theories of Hearing, Thesis, University of Leiden, Netherlands, 1950.

14. Davis, H., and Walsh, T. E.: The Limits of Improvement of Hearing Following the Fenestration Operation, Laryngoscope **60**:273-295, 1950.

15. Shambaugh, G. E., Jr.: Pure Tone and Controlled Speech Tests in the Selection of Cases for Fenestration, Acta oto-laryng., to be published.

16. Bekesy, G.: Über die Messung der Schwingungsamplitude der Gehorknocheln mittels einer kapazitiven Sonde, Akust. Ztschr. **6**:1-16, 1941.

that 25 db. is a good tentative figure; consequently, the expected results of a fenestration operation is a curve 25 db. below the bone-conduction audiogram of the patient after correction for the Carhart otosclerotic notch (Chart 7).

The validity of this simple formula for predicting the hearing result of fenestration in a particular patient is substantiated by the following observations:

1. A consecutive series of 100 fenestration operations in "A" patients was divided into five groups according to the average preoperative hearing loss by air conduction (Table 2). Theoretically, with no cochlear degeneration we should expect the average result in each group to approximate 25 db. of loss, with the greatest gains in the group with the greatest preoperative loss. Table 2 shows how close the actual results came to the theoretical result.

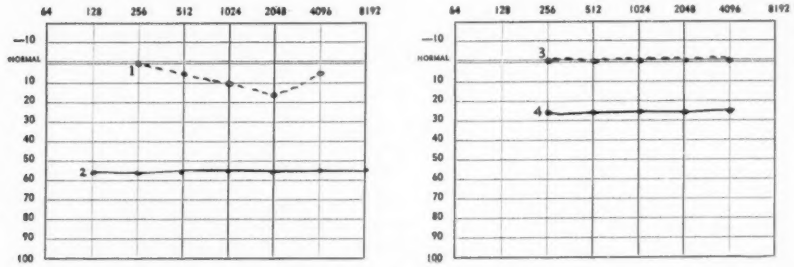

Chart 7.—Shambaugh formula for prediction of fenestration result is a curve 25 db. below the preoperative bone-conduction curve after correction for the Carhart notch. Line 1 shows bone conduction, Line 2 air conduction, Line 3 corrected bone conduction, and Line 4 predicted air conduction.

TABLE 2.—*Average Preoperative and Postoperative Pure-Tone Loss for the Frequencies 512, 1024, and 2048 in One Hundred Consecutive Fenestration Operations in Patients with Pure Stapes Ankylosis*

No of Cases	Average Loss Before Operation	Average Loss After Operation (6 Mo. to 1 Yr.)	Theoretical Anticipated Loss After Operation	Actual Gain After Operation	Theoretical Gain After Operation	"Surgical Deficit"
9	37.6 db.	28.3 db.	25 db.	9.6 db.	12.6 db.	3 db.
13	43.2 db.	25.7 db.	25 db.	17.5 db.	18.2 db.	0.7 db.
29	47.2 db.	24.8 db.	25 db.	22.4 db.	22.2 db.	+0.2 db.
25	52.7 db.	27.7 db.	25 db.	25.0 db.	27.7 db.	2.7 db.
24	59.1 db.	29.8 db.	25 db.	29.3 db.	33.9 db.	4.1 db.

2. If 20 db. of loss is the theoretical ceiling of postoperative hearing, how does one account for the rare patients who may attain a level of 10 or 15 db. after fenestration? The explanation is seen in the bone-conducted hearing in these patients, which reveals them to be persons with better-than-average cochlear function (Chart 8). One must remember that while the average hearing of 100 normal adults will be within 5 db. of the 0 line, there is a definite range of variation among normal persons with some showing a high normal curve at —10 and others a low normal curve at +10.

3. During the last six months we have predicted the result in candidates for fenestration by drawing a curve 25 db. below the corrected bone-conduction curve

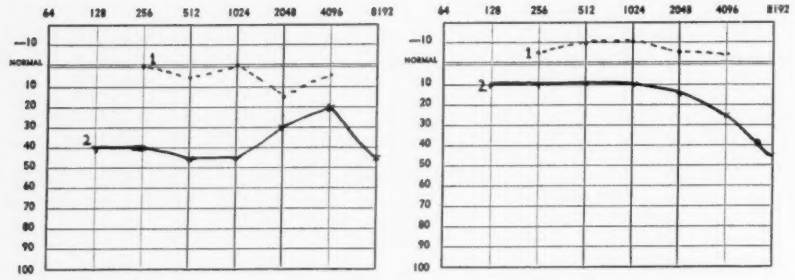

Chart 8.—Unusually good hearing after fenestration associated with a better-than-average bone-conduction curve. The chart on the left shows preoperative hearing and the chart on the right postoperative. Lines 1 show bone conduction and Lines 2 air conduction.

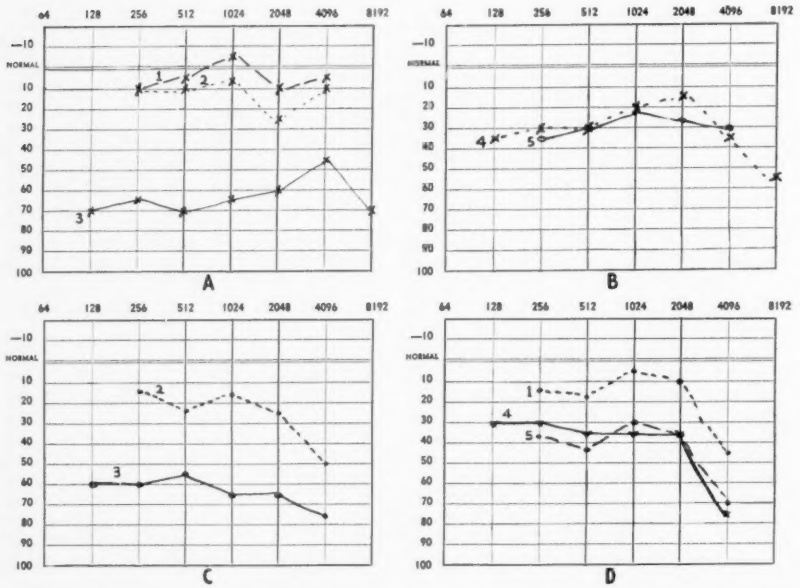

Chart 9.—Lines 1 show corrected bone conduction, Lines 2 bone conduction, Lines 3 air conduction, Lines 4 actual result, and Lines 5 anticipated result. *A* and *B*, patient with "A" suitability with hearing result within 4 db. of result predicted according to Shambaugh's formula. The actual gain was 42 db. and the anticipated gain 38 db. *C* and *D*, patient with "B" suitability with hearing result within 1 db. of prediction according to Shambaugh's formula. The actual gain was 35 db. and the predicted gain 36 db.

(taking the average of three preoperative bone-conduction audiograms to lessen errors inherent in audiometry). The actual result three months after operation in 75 patients has been within 3 db. of the predicted result in 62.7% and within 9 db. of the predicted result in 88%, revealing a high degree of consistency (Chart 9).

IMPORTANCE OF THE AIR-BONE-CONDUCTION GAP IN SELECTING PATIENTS FOR FENESTRATION

If, as Davis and Walsh and we believe, the fenestration operation leaves a residue of unrestored conductive hearing loss of 20 to 30 db. (average of 25 db.), then there is little or nothing to be gained by operating on patients with otosclerosis with an air-bone-conduction gap of less than 30 db. (average for the speech frequencies after correction for the otosclerotic notch) (Chart 10). Of 348 fenestration operations performed between August, 1949, and August, 1950, there were 36 "failures," that is patients whose hearing was not improved more than 10 db. for the speech frequencies by surgery. Half of these (18) had results

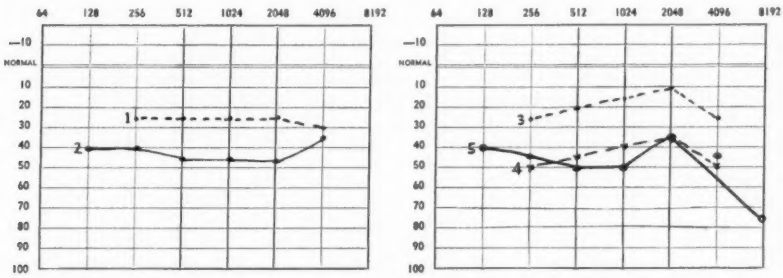

Chart 10.—Patient with otosclerosis with air-bone-conduction gap of less than 30 db., with no hearing improvement from fenestration. This failure was due to improper selection of patient for surgery. The chart on the left shows preoperative hearing and the chart on the right postoperative. Line 1 shows bone conduction, Line 2 air conduction, Line 3 corrected bone conduction, Line 4 predicted result, and Line 5 actual result.

within 9 db. of the predicted result (Shambaugh's formula), indicating that poor selection of patients for surgery has been an important cause for failures. By selecting only patients with an adequate air-bone-conduction gap of 40 db. or more these failures will be eliminated in the future.

The greatest gains will be obtained in patients with a maximum air-bone-conduction gap of 55 to 65 db. Patients who gain less than 15 db. for the speech frequencies are often little impressed by or enthusiastic about the results of surgery. Therefore, surgery is better delayed until the air-bone-conduction gap exceeds 40 db. As a rule patients who gain 35 to 40 db. of hearing are tremendously benefited and enthusiastic about the results of the operation, even though the final results fall a few decibels short of the 30 db. level of practical hearing. Accordingly, we are coming to place greater emphasis on a large air-bone-conduction gap in considering and advising fenestrations. We believe that a maximum air-bone-conduction gap is of importance almost equal to normal cochlear function as revealed by the corrected bone-conduction curve in selecting ideal patients for fenestration.

CONCLUSIONS

1. With proper precautions, bone-conduction audiometry is as consistent as air-conduction audiometry.

2. The air-conduction curve of stapes ankylosis shows an early "stiffness tilt" and a later "mass flattening."

3. The bone-conduction curve of stapes ankylosis shows a mechanical notching, largely reversed by fenestration. To ascertain the true cochlear reserve of a patient with otosclerosis, the bone-conduction audiogram should be corrected by adding 5 db. to the frequency 512, 10 to 1024, 15 to 2048, and 5 to 4096.

4. The air-bone-conduction gap measures the conductive component of the hearing loss. With a gap of less than 35 db. operation is contraindicated. An ideal patient has a maximum air-bone-conduction gap of 55 to 65 db., in addition to good cochlear reserve (corrected bone-conduction curve within 5 db. of the 0 line).

5. The fenestration operation leaves a "residue of unrestored conductive hearing loss" of 20 to 30 db.

6. The predicted result of a successful fenestration operation will be a curve 25 db. below the corrected bone-conduction curve.

7. Comparisons of the performance of the fenestrated ear with that of the hearing-aid-aided ear show that in ideal "A" patients surgery is the rehabilitative procedure of choice. In less suitable cases the results of surgery tend to be inferior to the hearing aid in volume of hearing though superior in clarity.

55 E. Washington St. (2).

3021 Hartzell Ave.

Case Reports

PRIMARY CHOLESTEATOMA OF THE MASTOID

GEORGE R. LAUB, M.D.
COLUMBIA, S. C.

A TUMOR which resembled a primary or true cholesteatoma of the mastoid was observed in an elderly man. Roentgenograms suggested a secondary cholesteatoma, but histological examination established the diagnosis of primary cholesteatoma without cholesterol crystals.

REPORT OF A CASE

M. C., a 72-year-old man, came to the hospital with complaints of a swelling behind his right ear which had lasted for the previous three months and occasional slight dizziness.

His past history showed that he had always had excellent health and his condition had been good except for some stomach ulcers which he had had a number of years ago. He had also received some shotgun wounds in his neck and chest about 25 years ago, which were accidentally discovered during the x-ray examination. He never had any ear complaints or discharge, pains, or the like. Examination of his ear revealed perfectly normal drum membranes without any perforation or scars. There was a marked swelling and redness of the skin directly behind the right ear, which pushed the pina outward. The swelling had a doughy consistency and was only slightly tender to pressure. The roentgen examination (Dr. George W. Smith Jr.) showed a "normally pneumatized mastoid on the left and a rather marked sclerosis in the periantral region of the right mastoid. There was also a large excavation in the petrous tip of the right mastoid which is probably due to cholesteatoma" (Fig. 1).

Because of these findings, mastoidectomy was done. After the outer layer of the mastoid was opened an apparently cystic mass was found which filled the entire cavity of the mastoid. It gave the appearance of having been previously operated on, since all the cell walls were missing. This cyst had a very thin, silky, pinkish wall. After the cyst was opened, no fluid but a very large amount of debris resembling granulations without any vascularization was found. The mass was removed and the wound closed. The postoperative course was uneventful, and the patient recovered completely in due time.

The histological examination (Dr. H. H. Plowden) of microscopic sections of this tissue showed that much the greater part of it was made up of dead, keratinized, degenerating, and liquefying stratified squamous epithelium. Scattered irregularly through the section were a number of fragments of organized tissue of fibrous connective character, covered on one surface by atrophic stratified squamous epithelium. The general appearance of this tissue suggested that this was originally an epithelial cyst lined by stratified squamous epithelium. Throughout the course of years the cyst had filled with degenerating, keratinous, desquamated epithelial cells. No cholesterol crystals were noted. There was no evidence of malignant degeneration in the sections.

The diagnosis was epithelial cyst (Figs. 2, 3, 4, and 5).

Because this case seemed to be very unusual, a section was sent to Dr. Franz Altman,[1] in New York, who made the diagnosis of cholesteatoma without cholesterol crystals.

COMMENT

Cholesteatomas were first described by Johannes Müller in 1838. They are characterized by formation of masses of epidermoid cells arranged in concentric layers, between which are found cholesterol crystals. In regard to etiology there

1. Altman, F.: Personal communication to the author.

are a number of theories. Rokitansky and Virchow considered a cholesteatoma a true and primary tumor. Wendt thought it to be the result of a chronic suppuration in which the epithelium of the middle ear undergoes a metaplastic change. Bezoldt-Haderman's theory is that of immigration in which extension of epidermis from the external canal occurs in an attempt to heal over the defects of the mucosa of the middle ear. Manasse thought that the epidermis of the canal or the tympanic

Fig. 1.—Roentgenogram of mastoid showing the cyst.

membrane takes on the activity of a new growth and invades the mucosa of the middle ear. Wittmaak believes that a sinking in or cupping of the pars flaccida with retention in the spaces of the middle ear may produce a "dry" cholesteatoma before the beginning of the suppuration. This type results from an ingrowth of the epithelium from Shrapnell's membrane without a preexisting perforation or otitis media. The primary, or true, cholesteatoma is the result of an embryonal rest and extremely rare. It occurs mostly in the atrium or attic but always origi-

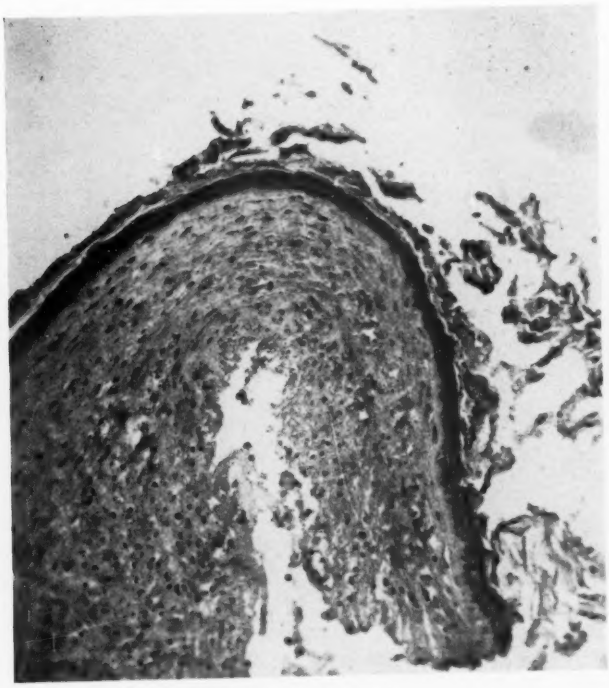

Fig. 2.—Cyst; × 150.

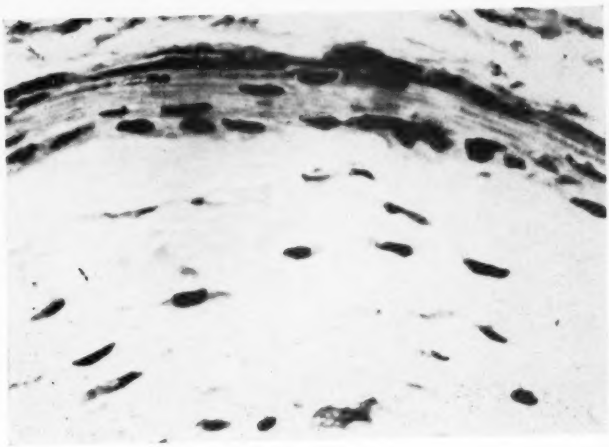

Fig. 3.—Cyst; × 750.

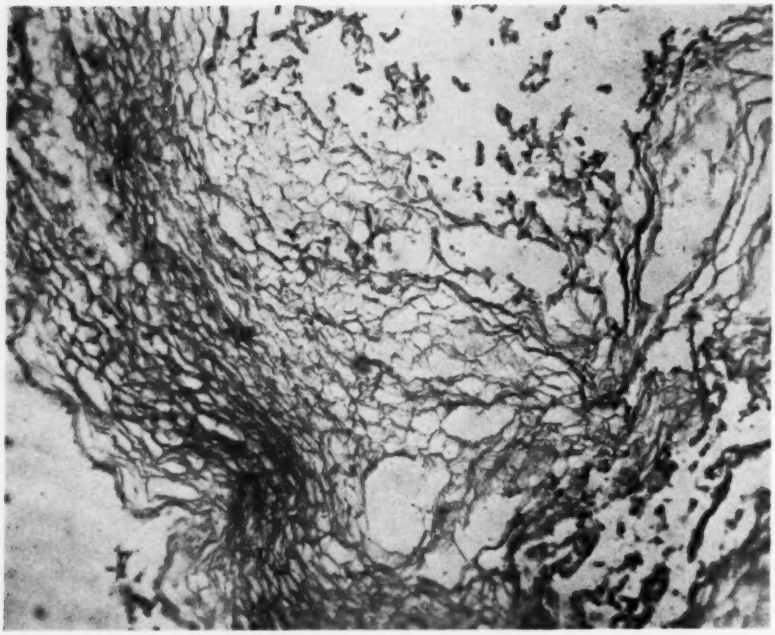

Fig. 4.—Contents of cyst; × 150.

Fig. 5.—Contents of cyst; × 750.

nates in the cavity where it is found. It is covered with a delicate membrane closely adherent to the periosteum to which it is attached.[2]

Cholesteatomas may be found in various bones of the skull. They are supposed to be epithelial rests which for some unknown reason begin to grow, forming a tumor which desquamates the cornified layers of its stratified squamous epithelium into a central cavity. The debris then disintegrates, forming cholesterol. The appellation cholesteatoma is, however, improper because often no cholesterol is present. Furthermore, there is often cholesterol in a chronic discharge when no tumor mass can be found. Epithelial growth has been found in temporal bones where there was no evidence of perforation or previous infection.[3]

Begley, McDonald and Williams recently made a very excellent study of cholesteatomas with a discussion of all the different theories of their histogenesis. They believe that the metaplasia theory of origin is the most plausible one. Their paper has a most complete bibliography which can be recommended to students of this subject.[4]

The study of the very meager literature shows that in our case we are dealing with a primary, or true, cholesteatoma. Its behavior was very much like that of a true tumor. It is interesting to note that the x-ray findings were typical of a cholesteatoma of the very common secondary kind, while the clinical diagnosis was rather difficult, probably because of the rarity of that condition.

Dr. John Walcott took the photographs.

2. Ballenger, W. L., and Ballenger, H. C.: Diseases of the Nose, Throat, and Ear, ed. 8, Philadelphia, Lea & Febiger, 1943, p. 660.

3. Fowler, E. P.: Medicine of the Ear, Ed. 2, Thos. Nelson & Sons, New York, 1948, p. 168.

4. Begley, J. W., Jr.; McDonald, J. R., and Williams, H. L.: Histology and Histogenesis of Cholesteatoma of the Middle Ear and Mastoid, A. M. A. Arch. Otolaryng. **53**:41 (Jan.) 1951.

Clinical Notes; New Instruments, and Techniques

NEW UNIVERSAL GRASPING FORCEPS FOR ENDOSCOPIC REMOVAL OF FOREIGN BODIES

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TRENTON, N. J.

With present instruments the art of removing foreign bodies from either the bronchi or the esophagus requires on occasions consummate skill and a broad array of instruments, both of which are not always available to the endoscopist who removes foreign bodies only occasionally. Some types of forceps, because of mechanical factors inherent in their construction, require complex manipulations which make them difficult for occasional use and demand preternatural skill on the part of the operator. Most available forceps have proximal parts which act as encumbrances to proper visibility when introduced into either an esophagoscope or a bronchoscope. This difficulty can be offset in most cases by withdrawing the forceps and then looking down along the cannula directly; but then the use of the working length of the forceps is lost, and a foreign body may be within tantalizing proximity and still not available to the grasp of the jaws.

The mechanical principles involved in the construction of any one type of forceps predetermine its limitations, advantages, and disadvantages. For example, a forceps depending on sliding for closure of the jaws must of necessity have a large proximal tapered bulk. This prevents buckling and adds strength but decreases visibility. Again in the case of the same forceps, the two halves of the body must be held together by springs or other types of binding; and once again bulk interferes with vision. Another forceps with a universal handle suffers from the same disadvantages of proximal bulk because of a lock which holds the interchangeable cannulae to the handle. In the same forceps distal bulk is presented by a ring used to secure the interchangeable jaws. The scissors type of cannulated forceps (which is a very popular type) is limited for occasional use because it requires a high degree of skill for successful application. In this type the principle of closure consists in the withdrawal of the jaws into a cannula, with the result that the jaws tend to move away from the object. A coordinate forward motion must be made to compensate for the withdrawal of the jaws. Again, with the same forceps, the leverages involved are such that the distal end of the forceps tends to rise when closed, and once more a downward compensating movement is required. These complicated movements are usually difficult to achieve except for those whose practice is such that the removal of foreign bodies is a daily occurrence.

DESIDERATA FOR AN IDEAL GRASPING FORCEPS

The following features are desirable: (1) mechanical construction on simple principles which will permit easy and early mastery of the instrument, and easy disassembly for cleaning and servicing; (2) delicate construction combined with powerful and secure grasping power; (3) construction such that traction can be made in the axis of the forceps body and not at an angle, permitting delicate construction with good visibility and great traction power; (4) a mechanism for locking the grasping jaws at any degree of tension so that continued closure will not depend on finger or hand pressure, (permitting manipulation and traction on the foreign body without the usual cramping and finger fatigue); (5) a forceps jaw which can grip at the point desired without retraction away from the foreign body; (6) jaw blades which can be opened and closed gradually and symmetrically at the point desired without jerky or uncertain motion, insuring a secure grasp as well as controlled dilatation of a bronchus (a forceps which does not have this type of control being apt to impact the foreign body more deeply into a bronchus); (7) facility for rotating and locking the jaws in any degree so that the foreign body may be engaged in the most favorable position; (8) possibility of a two-hand operation for greater stability of approach and engagement of the foreign body; (9) interchangeability of jaws for the same forceps to simplify the armamentarium and to adapt the forceps to the problem at hand.

Chief of Thoracic Medicine, St. Francis Hospital, Trenton, N. J.; Associate in Medicine, Graduate School of Medicine, University of Pennsylvania, Philadelphia.

PRINCIPLES OF CONSTRUCTION

The design of the forceps to be described was based as closely as possible on these desiderata.[1] The principle of closure was a departure from the conventional method used on most cannulated forceps. Closure is effected by moving an inner cannula over the jaws so that the jaws do not move at all but close at the exact point desired. No complex coordinate movements are necessary.

The body of the forceps consists of a wire jaw insert and an inner and an outer cannula. The handle is a rigid assembly brazed to the outer cannula and provided with a thumb rest for greater stability of grasp. The stylet attached to the jaws is locked to a post attached to the handle. The handle permits rotation and locking of the jaws in any position of a 360° circle. Closure of the jaws is accomplished by turning a knurled nut on a fast-running screw. The spread and tension of the jaw blades can be accurately controlled by moving the stylet in or out of the inner

The universal grasping forceps, showing a few of the numerous types of grasping inserts which are interchangeable in this forceps.

cannula and locking it in place in the post. The entire forceps is easily disassembled by removing a single holding screw in the handle.

In the design of this forceps, due advantage was taken of the available grasping inserts (Jackson type), since these have been tried and proved. The use of these gives to the forceps the versatility of the Jackson foreign body experience.

LENGTHS AND WEIGHTS OF THE GRASPING FORCEPS

Several years' experience and study resulted in limiting the number and weights of the forceps to those described below. It was found that one weight and one length could not very well cover

1. This forceps is presently being manufactured by the George P. Pilling and Son Company, 3451 Walnut Street, Philadelphia, to whom I have given the specifications for the instrument described.

all phases of foreign body removal. In design and construction removal of foreign bodies from the bronchi, esophagus, and stomach of an adult as well as of a child was considered.

The forceps are made to the following specifications: heavy, 58 cm. long; heavy, medium, light, 48 cm. long; light, 38 cm. long.

Thus it will be seen that an assortment of five forceps with interchangeable jaws to suit the individual taste as well as exigency will fairly well cover almost the entire range of routine foreign body removal.

METHOD OF USE

The universal grasping forceps lends itself to easy and early mastery. The principles of its use are much the same as those of any other forceps. Most of the work, however, is done with a two-hand operation, the left hand holding the handle and the right hand turning the knurled nut for closure. Once the foreign body is engaged and grasped, the hands are released and traction is made under direct vision with the right hand holding onto the post of the handle. This prevents finger fatigue and cramping and permits one to manipulate the foreign body under direct vision without fear of losing the grasp. Irregular foreign bodies are engaged in the most favorable position by rotating and locking the jaws at the angle desired before closing the forceps. Rounded and soft foreign bodies which are impacted in the lumen necessitate dilation of the bronchus, and this can be done by the use of the proper type of blade with good spring tension. When the bronchus is dilated to the proper degree, the blades are pushed forward gently and closed. Since the dilation with these forceps is gradual and gentle and visibility good, foreign bodies of this type are more easily removed.

For fluoroscopic removal, the delicate construction of the lightweight forceps will permit it to enter deeply into the tracheobronchial tree. A one-hand operation can be effected by the operator, if he so desires, by grasping the handle underhand with the little, ring, and middle fingers about the handle; the forefinger is used to steady the proximal end and the thumb used to rotate the knurled nut for closure.

In the case of long, sharp foreign bodies impacted across the lumen of either the esophagus or the bronchi these forceps, because of their delicate construction and excellent visibility, permit the use of two forceps simultaneously to disengage this type of foreign body. When both ends of the foreign body are locked in the forceps, it becomes rather easy to control and remove this type of foreign body.

A sponge-carrier type of insert has also been adapted to these forceps so that they can be used in lieu of the usual sponge carriers, thus further increasing their versatility.

306 Hamilton Ave. (9).

SELF-RETAINED PALATAL RETRACTOR AND MOUTH GAG

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In recent years many articles stressing the need for visualization of the nasopharynx both for diagnostic and for surgical purposes have been published. To mention a few: Guggenheim [1] has described his technique for direct adenoidectomy; Dalton [2] devised a self-retaining illuminating palate retractor, and Meltzer [3] has stressed the value of direct adenoidectomy for the prevention of deafness.

The adjustable self-retaining palatal elevator and mouth gag to be described, which fills a long-felt need in otolaryngology, combines the advantage of exposing the epipharynx and allowing the operator the free use of both his hands without the aid of an assistant. This palatal elevator can be moved horizontally and anchored in a fixed position to the soft palate. By an upward turn

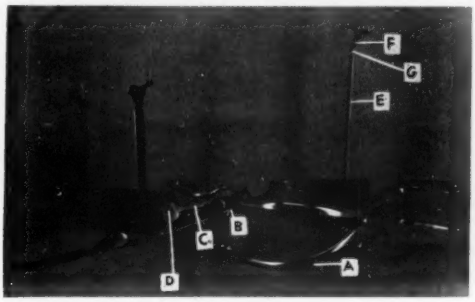

Fig. 1.—*A*, mouth gag; *B*, platform with palatal elevator; *C*, bolt; *D*, knob of bolt; *E*, shaft and *F*, palatal end, of palatal elevator; *G*, angle.

it can also elevate the soft palate and expose the nasopharynx. It has practical use for the removal of faucial tonsils, islands of lymphoid hyperplastic, and lateral pharyngeal, tissues.

The instrument [4] consists of a Jansen mouth gag and a platform grooved below to engage various-sized palatal elevators. A bolt 2½ in. (6.4 cm.) in length passes above and through the center of the platform. The outer end of the bolt has a round knob; the inner end consists of a ball-and-socket joint. This serves to adjust the platform upward or downward. The shaft of each palatal elevator fits into the mouth of the platform accurately. There are four sizes of palatal elevators, each to be used according to the depth of the throat. The palatal end is wide, concave

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1. Guggenheim, L.: Direct Adenoidectomy, Arch. Otolaryng. **33**:314-315 (Feb.) 1941.

2. Dalton, S. E.: Self-Retaining Illuminating Plate Retractor, Tr. Am. Acad. Ophth. (1941) **46**:151 (Jan.-Feb.) 1942.

3. Meltzer, P. E.: Surgical Procedures Directed Toward Prevention of Hearing Impairment in Children, Laryngoscope, 1225-1237 (Nov.) 1949.

4. The Self-Retained Palatal Retractor and Mouth Gag is manufactured by Codman & Shurtleff, Inc., 104 Brookline Ave., Boston.

below, convex above, beveled, angulated, and lipped. It engages the palate and remains in the adjusted operating position. The other end is corrugated above, below, and laterally for a distance of ½ in. (1.3 cm.). It serves as a grip to facilitate adjustment anteriorly and posteriorly.

After the patient is properly anesthetized, the mouth gag with the selected palatal elevator in its platform opening is put into the mouth. The mouth is opened, the shaft of the elevator is moved anteriorly or posteriorly until the soft palate is properly engaged at this point. A tonsillectomy can be performed if planned. By turning the knob of the bolt clockwise, the platform with the elevator will stretch the soft palate superiorly and expose the epipharynx. The adenoidectomy may be performed with the Laforce adenotome and punch forceps. The knob may be turned counter clockwise to release the tension of the palate.

Fig. 2.—Self-retaining palatal elevator and mouth gag in position. View of nasopharynx with adenoids exposed.

This combined palatal elevator and mouth gag has the following advantages:

1. No assistant is necessary to do direct adenoidectomy when this instrument is used.

2. The operator has the free use of both hands for surgical procedures.

3. The instrument can engage the palate of patients of all ages by its varied sized elevators, and it can be kept in the adjusted position throughout the operation.

4. It is easily managed and adjusted.

5. It serves to visualize the nasopharynx for more accurate surgery in the prevention of deafness.

6. It is an ideal instrument for secondary adenoidectomy, or in the final inspection of the nasopharynx for bleeding points, adenoid or any residual lymphoid tissue following the operation.

475 Commonwealth Avenue

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology for 1949-1950

INTRACRANIAL COMPLICATIONS IN OTOLARYNGOLOGY

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CHICAGO

SINCE the advent of sulfonamides and the antibiotics of the past decade, the decrease in otorhinogenous intracranial complications has been remarkable. Despite this fact, however, reports of such complications are still appearing in the literature with fair regularity.

The reasons for the continuation of these occasional complications are varied and speculative. Many authors believe that many otorhinogenous infections still must be treated with adequate surgical drainage in addition to sulfonamides or antibiotics to safeguard against intracranial complications. Maxwell [1] stated that common causes for failure in the treatment of the original infection are (1) starting the use of specific drugs too late; (2) inadequate therapy, either by too small amounts of chemotherapeutic agents or by timid and intermittent administration of these agents, and (3) use of nonspecific therapy, i. e., treating an infection with a nonspecific agent, emphasizing the need for routine cultures.

RHINOGENOUS COMPLICATIONS

Maxwell [1] stated that in general most of the intracranial complications of suppurative frontal sinus diseases are neurosurgical problems. The rhinologist, however, is responsible for the treatment of the acute sinus infections and for the recognition of their complications. Intracranial complications from acute suppurative frontal disease occur more frequently in cases of fulminating infections from Hemophilus influenzae bacillus, infections due to the acute exanthematous diseases, and infections resulting from swimming or diving. The intracranial complications of suppurative frontal sinus disease of which the rhinologist must be aware are (1) osteomyelitis of the skull, (2) epidural abscess, (3) epidural hemorrhage, (4) diffuse subdural abscess, (5) thrombosis of the superior longitudinal sinus, (6) leptomeningitis, (7) cavernous sinus thrombosis, (8) diffuse purulent encephalitis, and (9) localized frontal lobe abscess.

Maxwell reviewed briefly the pathogenesis of these complications, the signs of intracranial extension of the infection, and points helping to differentiate between these complications. Of unusual interest are the two cases of epidural hemorrhage cited. The first of these patients had a massive epidural hemorrhage, secondary to chronic suppurative otitis media and mastoiditis, and his rapid, downhill course terminated in death. Treatment was delayed because brain abscess was the original diagnosis. The second was a 21-year-old man who had right frontal headache and drowsiness three weeks following successful treatment of a furuncle on the right nasal ala with penicillin. On roentgenologic examination, there was found to be a

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1. Maxwell, J. H.: Acute Suppurative Frontal Sinusitis: Intracranial Complications, Ann. Otol. Rhin. & Laryng. **59**:451 (June) 1950.

small rarefied area in the right frontal bone suggesting an osteomyelitis. There was dilation of the homolateral pupil. A ventriculogram demonstrated a massive shift of the ventricular system to the left with depression of the frontal horn of the right lateral ventricle. A trephine opening near the osteomyelitic area exposed a massive extradural hemorrhage which had pushed the dura and frontal lobe toward the middle fossa. A hemolytic Staphylococcus aureus was grown from a culture. The tentorial pressure cone syndrome in intracranial hemorrhage usually reveals a dilatation of the homolateral pupil and later positive pyramidal tract reflexes, i. e., Babinski sign, etc. If the hemorrhage is arterial, the patient may succumb rapidly; if the bleeding is venous, as probably occurred in the second case, the patient may be able to tolerate the slowly forming pressure cone for several days. Immediate surgery is the treatment of choice when this condition is recognized.

In a 10-year survey of frontal sinusitis at the Los Angeles County Hospital (1938 to 1948), Johnson [2] presented 143 cases of frontal sinusitis from the standpoints of sex, race, age, seasonal incidence, predisposing cause, and mortality rate before and after the advent of penicillin. He concluded that the incidence of frontal sinusitis has not dropped with the advent of penicillin therapy but complications and deaths have decreased markedly. He stated that the severity of the infection and incidence of the causative organism are important factors in the production of complications.

Herberts [3] reviewed the anatomy of the frontal sinuses and the pathogenesis, symptomatology, and diagnosis of osteomyelitis of the frontal bone. He reported six patients with frontal osteomyelitis following sinusitis and one with maxillary sinusitis complicated by meningitis and cavernous sinus thrombosis. Four patients with frontal osteomyelitis were treated by radical frontal sinusotomy combined with intensive sulfonamide therapy. Three patients recovered; the fourth had a fulminating course and died of subdural and brain abscesses. The other three were treated by combined sulfonamide and penicillin therapy in addition to surgery, and all recovered. One patient with frontal osteomyelitis and the patient with maxillary sinusitis complicated by meningitis and cavernous sinus thrombosis were treated, in addition, with heparin and bishydroxycoumarin (dicumarol®). The author cited an interesting in vitro experiment in which penicillin, which is not bound to the plasma proteins as are sulfonamides, is shown to penetrate a blood coagulum readily. Sulfonamides are unable to penetrate a blood coagulum, but their bacteriostatic effect is increased with the addition of heparin in a substrate containing blood. The author concluded that with the adjunct of penicillin, more conservative surgery is possible with frontal osteomyelitis, and he advocated penicillin and sulfonamides combined with anticoagulant therapy in severe infections, especially if there is evidence of progressive thrombophlebitis or dural sinus thrombosis.

Smith, Latella, and Schnee [4] reported an interesting case of angiofibrosarcoma, an extremely rare tumor involving the paranasal sinuses, in a 27-year-old Negro

2. Johnson, F.: Ten Year Study of Frontal Sinusitis at the Los Angeles County General Hospital, Arch. Otolaryng. **52**:129 (Aug.) 1950.

3. Herberts, G.: Frontal Osteomyelitis: Its Treatment and Some Experimental Observations on the Effect of Heparin in Combination with Sulfonamide and Penicillin Therapy, Acta otolaryng. **37**:321 (Aug.) 1949.

4. Smith, M. T.; Latella, P. D., and Schnee, I. M.: Angio-Fibrosarcoma of the Ethmoid and Frontal Sinuses Complicated by Osteomyelitis of the Frontal Bone and Epidural Abscess, Ann. Otol. Rhin. & Laryng. **59**:650 (Sept.) 1950.

man. The tumor extensively involved the right nasal fossa, the right ethmoid labyrinth, and both frontal sinuses and was complicated by frontal osteomyelitis and an epidural abscess. The patient was treated with sulfadiazine and penicillin and, surgically, by a radical exenteration of the tumor and the involved osteomyelitic bone in two stages. X-ray therapy was given postoperatively. The patient recovered completely, and there was no evidence of recurrence of the tumor four years later. The authors emphasized the masking effects of the sulfonamides, well illustrated in this case by subsidence of symptoms despite progression of the lesion.

Winborn [5] reported five cases of frontal osteomyelitis, secondary to frontal sinusitis. In two cases there was complication by epidural abscess, in one by brain abscess, in one by meningitis, and in one by multiple metastatic pulmonary abscesses. All the patients were treated with penicillin, sulfonamides, and conservative surgery, with recovery. The author concluded that extensive surgery is not necessary and mortality is low in frontal sinus complications when they are treated with conservative surgery in conjunction with penicillin and sulfonamides. A point of probable significance was the fact that four of the five patients with osteomyelitis had an antecedent history of trauma to the forehead.

Subdural empyema has always been one of the uncommoner and one of the most lethal frontal sinus complications. Since the advent of chemotherapeutic agents, however, reports of successful treatment of this complication are beginning to appear in the literature. Mufson and Wagner [6] reported a case of subdural empyema in a 29-year-old woman following an acute frontal sinusitis with osteomyelitis. The patient was treated with large doses of penicillin and sulfonamides, surgical drainage through a frontal burr hole, and later by radical frontal sinusotomy and removal of the osteomyelitic bone. The patient recovered. The authors stressed the treatment with large doses of penicillin and sulfonamides and early surgical intervention. The most important consideration is in differentiating a subdural abscess from a brain abscess. As a rule the onset of brain abscess is milder and more insidious, the temperature is not as high, and the illness is more drawn out. Surgery is usually delayed to wait for encapsulation. In subdural empyema, on the other hand, a patient has an acute fulminating infection with high fever, prostration, leucocytosis, and rapidly developing coma and requires immediate operation. The authors pointed out, however, that brain abscesses may accompany or even follow subdural empyema.

Simonton and Anthony [7] reviewed briefly the literature and the pathogenesis of meningitis following nasal polypectomy, a complication which is still encountered occasionally. They reported five cases of meningitis at the Mayo Clinic which had occurred in the preceding two years, following intranasal polypectomy combined with exenteration of the ethmoid cells. They concluded that penicillin postoperatively does not prevent the occurrence of meningitis, which is still a definite risk after intranasal ethmoid polypectomies. Sulfonamides given early, in adequate and prolonged dosage, is the treatment of choice for the meningitis.

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5. Winborn, C. D.: Frontal Sinus Infections—Complications and Management, Ann. Otol. Rhin. & Laryng. **58**:280 (March) 1949.

6. Mufson, J. A., and Wagner, M.: Acute Subdural Empyema: Secondary to Frontal Sinusitis, Arch. Otolaryng. **51**:535 (April) 1950.

7. Simonton, K. M., and Anthony, W. P.: Meningitis Following Nasal Polypectomy, Laryngoscope **59**:169 (Feb.) 1949.

Brain abscess secondary to ethmoiditis is an extremely rare complication. Kler [8] reviewed the pathogenesis of such a complication and presented three cases, in two of which there was recovery. One case was secondary to acute ethmoiditis, the others were secondary to chronic ethmoiditis. He stated that complications from acute ethmoiditis are more frequent and are more easily diagnosed than those of chronic ethmoiditis. Abscess of the brain as a complication of chronic ethmoiditis is an encapsulated abscess that gives few general or localizing signs. Papilledema and headache were the most constant findings, and electroencephalography was found invaluable in the diagnosis. The author emphasized that the assistance of the neurosurgeon in these cases is essential.

Relatively few reports of complications from sphenoiditis have appeared in recent literature. Ewertsen [9] reported two cases of acute sphenoiditis in previously healthy adults leading to death from meningitis (in both) and cavernous sinus thrombosis (in one). One case occurred before the days of antibiotics. In the other case adequate treatment was given with sulfonamide, penicillin, and streptomycin. The diagnosis was not made ante mortem for either patient, and surgical drainage was not instituted. The author stated that constant occipital headache is the most reliable symptom of sphenoiditis; the pain is usually worse at night and is not influenced by the usual headache remedies, and there may be reflex pain via the trigeminal ganglion to the ear, canine fossa, or soft palate. The stiff neck is usually more pronounced than is that due to meningitis alone. Antibiotics and adequate surgical drainage of the sphenoid sinus are necessary for recovery.

Rongetti and Daniels [10] reported an interesting and unusual case of a 65-year-old man who presented himself with severe headache, chills, projectile vomiting, thirst, and malaise. There was a concentric restriction of the visual fields, ptosis of the right eyelid, and paralysis of the right lateral rectus. Roentgenograms revealed bone erosion and destruction of the sella turcica. This was thought to be a primary neoplasm, and, at craniotomy, a very soft diaphragma sellae was found and aspiration of the sphenoid sinus revealed pus under pressure. The diagnosis established then was empyema of the sphenoid sinus resulting in osteomyelitic destruction of the floor of the sella turcica. The patient later required a left ethmoidectomy and uncapping of the sphenoid sinus. He received penicillin parenterally and penicillin drip locally via a mushroom catheter left in the sphenoid sinus for three days, with complete recovery.

Birdsall [11] reported a case of frontal lobe abscess secondary to acute suppurative sphenoidal sinusitis in a previously healthy young adult. The diagnosis was not suspected, and surgical drainage was not secured. The patient died despite adequate doses of penicillin over a six-day period.

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8. Kler, J.: Abscess of the Frontal Lobe Secondary to Ethmoiditis, Arch. Otolaryng. **49**:125 (Feb.) 1949.

9. Ewertsen, H. W.: Isolated Acute Sphenoiditis Causing Meningitis, Acta Otolaryng. **37**:563, 1949.

10. Rongetti, J. R., and Daniels, J. T.: Treatment of Empyema of the Sella Turcica of Sphenoid Origin, Arch. Otolaryng. **52**:166 (Aug.) 1950.

11. Birdsall, S. E.: Acute Suppurative Sphenoidal Sinusitis with Frontal Lobe Cerebral Abscess, J. Laryng. & Otol. **65**:196 (March) 1951.

OTOGENOUS COMPLICATIONS

Foertsch and Fischer [12] reported a case of circumscribed meningitis due to a Type 5 Diplococcus pneumoniae which was secondary to an acute exacerbation of a chronic otitis media in a 47-year-old man. The patient was treated with penicillin injected intrathecally, 50,000 units, an immediate modified radical mastoidectomy, and penicillin and sulfonamide postoperatively. At the operation a defect was found in the mastoid tegmen, and in this area the dura was purple and edematous. The recovery was uneventful. The authors stressed the potential dangers of penicillin given intrathecally in such cases, i. e., neurogenic disturbances of the bladder, transverse myelopathy, convulsions, and headaches, and emphasized that surgical drainage is necessary in addition to sulfonamide and penicillin in the treatment of this condition.

On the other hand, Rudberg and Sjöberg [13] stated that penicillin should be given intrathecally in the treatment of otogenic purulent meningitis. Eight cases of otogenic meningitis and one case of meningitis following acute sinusitis were presented. Five cases were complications of acute otitis media; three developed in ears previously operated on. The patients were treated with high doses of sulfamerazine, penicillin given intramuscularly and intrathecally, and mastoidectomy. Eight patients recovered, and one (who was moribund on admission) died. The authors felt that penicillin intrathecally is an important part of the treatment and cited three patients who responded fairly dramatically to this treatment after becoming progressively worse on intramuscularly administered penicillin alone.

Davidson and Alden [14] reported an interesting case of pneumococcic meningitis secondary to an acute otitis media in a 59-year-old woman, which was treated successfully by large doses of sulfadiazine and by a simple mastoidectomy. The patient was well for five years, then had a recurrence of the pneumococcic meningitis due to an acute exacerbation of the chronic otitis media. This time the meningitis was controlled by large doses of penicillin and sulfonamide; no surgery was necessary the second time.

Shuster and Gordon [15] reported a case of Type 3 D. pneumoniae meningitis secondary to an acute exacerbation of a chronic otitis media in a 65-year-old man who was admitted to the hospital in a stuporous condition and with a temperature of 105 F. He was immediately treated by simple postaural mastoidectomy, with exposure of the dura of the middle and posterior fossae. He was given sulfonamide and penicillin parenterally. In addition, he was given penicillin intrathecally for two days. The recovery was complete.

Boemer [16] reported a case of pneumococcic meningitis in a 55-year-old woman secondary to an acute otitis media. The treatment consisted of penicillin given

12. Foertsch, J. H., and Fischer, A. J.: Pneumococcic Meningitis—Presentation of a Case with Operation and Recovery, Arch. Otolaryng. **49**:637 (June) 1949.

13. Rudberg, R., and Sjöberg, A.: On Prognosis and Therapy in Oto-Rhinogenous Meningitis, J. Laryng. & Otol. **63**:446 (Aug.) 1949.

14. Davidson, M., and Alden, A. M.: Recurrent Pneumococcus Meningitis: Report of a Case, Laryngoscope **59**:1276 (Nov.) 1949.

15. Shuster, B. H., and Gordon, W.: Meningitis, Pneumococcic Type 3; Mastoidectomy, Recovery, Arch. Otolaryng. **52**:650 (Oct.) 1950.

16. Boemer, L. C.: Recovery in Otitic Pneumococcic Meningitis: A Case Report, Arch. Otolaryng. **50**:669 (Nov.) 1949.

intramuscularly and intrathecally, sulfonamides, and a radical mastoidectomy, with complete recovery.

As yet, few reports have appeared in the literature concerning the usage of the newer antibiotics in the treatment of otorhinogenous intracranial complications. Judge and Davis [17] cited a case of Escherichia meningitis following a radical mastoidectomy in a 25-year-old man for chronic suppurative otitis media. The meningitis developed while the patient was receiving penicillin therapy and did not respond to combined penicillin-sulfonamide treatment. After chloramphenicol (chloromycetin®) administration was started, the response was fairly dramatic as evidenced by rapid disappearance of Esch. coli from the spinal fluid, rapid drop in the spinal fluid leucocyte count, and rapid improvement of the patient. Chloramphenicol is an antibiotic having five times the power of streptomycin (formerly the most effective drug for Esch. coli) to inhibit the growth of Esch. coli and seems the drug of choice for treatment of Esch. coli meningitis at the present time. It was given for two weeks without any toxic effects.

Nako [18] reported a case of acute otitis media complicated by petrositis and meningitis, as evidenced by trigeminal neuralgia, decalcification of the petrous pyramid, and turbid spinal fluid under increased pressure. The patient was treated by penicillin given parenterally and intrathecally. A simple mastoidectomy was performed first followed later by a radical mastoidectomy, but the petrous apex was not drained. The author recommended Frenckner's operation for petrositis when it is possible.

Medwick, Uihlein, and Hallberg [19] presented six cases of cerebellar abscess following otitis media, which had occurred in the past 10 years at the Mayo Clinic. Four cases were secondary to chronic otitis media, and two cases were secondary to acute otitis media; four patients survived. The two deaths occurred in 1938 and 1940. The treatment consisted of craniotomy and evacuation of the abscess either before or during mastoidectomy. It was felt that the primary focus in the mastoid must be removed and that the optimal time of operation is when encapsulation of the abscess has occurred. The route should be through the mastoid portion of the temporal bone when the adjacent portion of the dura is eroded; however, a surgical approach through a clean field should be done when a definite preformed pathway is not found. Surgical drainage of the abscess and eradication of the primary focus in the mastoid, combined with penicillin and sulfonamide in large doses, was thought to be the treatment of choice. Close cooperation between the otologist and neurosurgeon is essential in this condition.

Brunner [20] stated that the otologist should continue to treat the otogenous brain abscesses. He presented three cases of temporal lobe abscess of otitic origin and

17. Judge, A. F., and Davis, W. L.: Otogenic Meningitis Due to Escherichia Coli: Treatment with Chloromycetin, Laryngoscope **60**:186 (Feb.) 1950.

18. Nako, A.: Recovery from Petrositis Associated with Meningitis After Penicillin Treatment, Acta oto-laryng. **37**:153 (April) 1949.

19. Medwick, J. X.; Uihlein, A., and Hallberg, O. E.: Abscess of the Cerebellar Lobe of Otogenic Origin: Combined Otolaryngological and Neurosurgical Treatment in 6 Cases, Arch. Otolaryng. **50**:429 (Oct.) 1949.

20. Brunner, H.: Treatment of Otogenous Temporal Lobe Abscess, Ann. Otol. Rhin. & Laryng. **59**:943 (Dec.) 1950.

briefly reviewed 33 other such cases. All three patients were treated with penicillin given parenterally and intrathecally, sulfonamides, and surgery, with recovery.

Harper [21] emphasized the importance of aphasia as a symptom in otogenic brain abscess as a means of localization. When present, aphasia usually localizes the abscess in the left temporosphenoidal lobe in right-handed patients and in the right temporosphenoidal lobe in left-handed patients. He presented an illustrative case and discussed sensory and motor aphasia in detail.

Harpman [22] discussed in detail the problem and techniques of treating otogenic brain abscess. He reported 18 cases of brain abscess since 1941 and divided these into two groups from the standpoint of time. In the earlier group of eight, seven patients died; in the later group of 10, 9 survived. He attributed this remarkable reduction in mortality in the last group to the use of antibiotics and sulfonamides, drainage of the abscess as soon as it was diagnosed, its thorough initial evacuation, laying it well open to ensure healing without pocketing, and adequate treatment of the underlying and accompanying lesion.

Wilmot [23] reported a case of cerebellar abscess secondary to chronic suppurative otitis media with cholesteatoma. It was treated by the draining of the abscess via a simple mastoidectomy approach, with a drain left in the abscess cavity. The abscess cavity was irrigated with penicillin solution every day, and the patient received penicillin systemically as well. The mastoidectomy was converted into a radical cavity a few days after the first operation. Recovery was uneventful and complete.

Shuster and Marks [24] reported the case of a 12-year-old boy with meningitis and a right temporosphenoidal lobe abscess secondary to chronic suppurative otitis media and mastoiditis. A similar postaural mastoidectomy was performed, and then the abscess was entered via the squamous part of the temporal bone. A drainage tube was left in the abscess cavity, which was gradually removed. The authors believed that minimal manipulation of the abscess cavity and the use of sulfonamide and penicillin were important factors in the child's recovery.

Toomey and Hutt [25] briefly reviewed the anatomy of the dural venous sinuses in an effort to demonstrate the relation of lesions of the dural sinuses to the signs and symptoms produced. The marantic and septic types of sinus thrombosis were discussed separately, and 61 cases of dural sinus thrombosis from 1921 to 1947 were described.

The superior petrosal sinus receives as tributaries the tympanic veins draining the middle ear and mastoid. It opens into the lateral sinus at the point at which the lateral sinus bends to become the sigmoid sinus. According to Bauer,[26] thrombo-

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21. Harper, A. R.: Aphasia as a Symptom of Otogenic Brain Abscess, J. Laryng. & Otol. **65**:89 (Feb.) 1951.

22. Harpman, J. A.: On the Treatment of Otogenic Brain Abscess, J. Laryng. & Otol. **64**:319 (June) 1950.

23. Wilmot, T. J.: Cholesteatoma Causing Cerebellar Abscess, J. Laryng. & Otol. **63**:682 (Nov.) 1949.

24. Shuster, B. H., and Marks, M. A.: Recurring Mastoiditis, Meningitis and Abscess of Right Temporosphenoidal Lobe: A Case Report, Arch. Otolaryng. **50**:462 (Oct.) 1949.

25. Toomey, J. H., and Hutt, H. B.: Thrombosis of the Dural Sinuses, Am. J. Dis. Child. **77**:285 (March) 1949.

26. Bauer, F.: Thrombophlebitis of the Superior Petrosal Sinus, J. Laryng. & Otol. **65**:199 (March) 1951.

phlebitis of the tympanic veins is probably a common occurrence in middle ear infections, and presumably the spread of the thrombophlebitis may spread to the superior petrosal sinus and thence to the lateral sinus. The superior petrosal sinus lies in relation to the main trunk of the trigeminal nerve, which may become irritated in the presence of a thrombophlebitis of the superior petrosal sinus causing facial neuralgias, especially toothache or pain in the lower jaw. Bauer believed this to be of surgical importance and stated that if thrombophlebitis of the superior petrosal sinus is suspected (facial neuralgia, etc.) the lateral sinus should be exposed and inspected. He presented an illustrative case.

Smith [27] presented a series of 30 cases of otogenous thrombophlebitis of the lateral sinus and jugular bulb in two groups. The first was a group of 22 patients treated before the introduction of the antibiotics. Many were treated by evacuation of the thrombus with or without jugular vein ligation. There were seven deaths in this group. The second group numbered eight patients treated after the antibiotics were available. All these recovered after operation on the lateral sinus, and none had an operation on the jugular vein. He stated that anticoagulants should further aid in the treatment of this condition, but he had not used these agents.

Latella and Hopkins [28] presented a review of the recent literature on lateral sinus thrombosis and the opinions concerning the management of this condition. They presented a case of lateral sinus thrombosis secondary to an acute exacerbation of a chronic otitis media. A mastoidectomy was performed and the sinus was exposed from the torcula to the bulb; the lateral sinus was resected and the jugular vein was ligated in the neck. The mastoid was revised later; antibiotics were given and the patient recovered.

Hadfield and Hinde [29] presented two cases of lateral sinus thrombosis secondary to chronic suppurative otitis media. One patient recovered after two revisions of the first mastoidectomy. The lateral sinus was not opened during the first operation, but it was opened at the second operation and the clot was evacuated. The second patient died with multiple pulmonary abscesses because thrombophlebitis was not recognized at the time of the original mastoidectomy. The authors emphasized the fact that too much reliance should not be placed on antibiotics in the treatment of lateral sinus thrombosis and that the antibiotics are not adequate substitutes for surgical eradication of this condition.

Among the various intracranial complications of suppurative otitis media is included the syndrome termed "otitic hydrocephalus" by Symonds in 1931. Other terms which apparently have been applied to the same syndrome are "cerebral pseudo-abscess," "meningismus," "serous ependymitis" or "meningitis," "arachnoiditis," "hypertensive meningeal hydrops," "toxic hydrocephalus," "otogenous edema of the brain," and "otogenous nonpurulent encephalitis." Horowitz [30] pointed

27. Smith, A. B.: Otogenous Thrombophlebitis of the Lateral Sinus and Jugular Bulb, J. Laryng. & Otol. **64**:12 (Jan.) 1950.

28. Latella, P. D., and Hopkins, J. H.: Lateral Sinus Thrombosis: Review of Recent Literature and Report of a Case, Ann. Otol. Rhin. & Laryng. **58**:997 (Dec.) 1949.

29. Hadfield, E. H., and Hinde, R. T.: Two Cases of Lateral Sinus Thrombosis, J. Laryng. & Otol. **63**:605 (Oct.) 1949.

30. Horowitz, S.: Otogenic Intracranial Hypertension, J. Laryng. & Otol. **63**:363 (July) 1949.

out that in this condition the term "hydrocephalus" is not justified because encephalographic examination shows that the ventricles are not enlarged and, in fact, may be smaller than usual. He preferred, therefore, the term "otogenic intracranial hypertension." The syndrome is oftenest found in children and young adults and may complicate either acute or chronic otitis media and mastoiditis. There is increased intracranial pressure, usually causing headache, nausea, and vomiting and a papilledema, usually accompanied by small hemorrhages and occasionally by small patches of exudate. Lumbar puncture is essential in making this diagnosis. The pressure is high, varying from 300 to 900 mm. of water, but the spinal fluid is normal in dynamics and according to the results of bacteriological and biochemical analyses. The condition usually clears up after weeks or a few months of appropriate treatment, but if treatment is not carried out or is delayed too long optic atrophy and blindness may result. Horowitz presented three cases of otogenic intracranial hypertension, in all of which the patient recovered. They were treated with sulfonamide and penicillin and appropriate mastoid surgery, plus a decompression procedure, subtemporal usually. He pointed out that some of these patients recover merely from repeated lumbar puncture decompression. The etiology of the syndrome is still in doubt. The author believed that it may be due to marked engorgement of the intracranial veins.

Smith and Mirmelstein [31] also reviewed briefly the signs and symptoms of "otitic hydrocephalus." They pointed out that in many cases there is complete response to one or more lumbar punctures, whereas in a few cases decompression operations are required for the prevention of blindness from optic atrophy. They reported a case of acute exacerbation of a chronic otitis media in a 27-year-old man leading to headache, papilledema, and increased spinal fluid pressure. The patient was treated with penicillin and streptomycin, radical mastoidectomy, and subtemporal decompression, with eventual recovery. The final diagnosis was "otitic hydrocephalus."

Brunner [32] reviewed briefly the thoughts concerning the pathogenesis and actual pathology of otogenous edema of the brain ("otitic hydrocephalus," "otogenic intracranial hypertension," etc.) and pointed out that its pathogenesis is still speculative. He stated that the condition usually occurs in young people and children and that there is an onset of fever, chills, and headache. The spinal fluid is normal, but the pressure is increased. Jacksonian attacks, cerebellar fits, opisthotonos, hemiplegia, monoplegia, etc., may occur. At operation the dura is found to be normal or there is a pachymeningitis. The cerebral cortex is slightly hyperemic, and there is moderate herniation of the brain subsequent to incision of the dura. The treatment must be removal of the focus of infection and decompression of the brain. He presented two illustrative cases in which there was complete recovery.

Borries [33] preferred the term "otogenic non-purulent encephalitis." He reviewed the literature on this syndrome and discussed in detail the symptomatology and

31. Smith, A. T., and Mirmelstein, A.: Otitic Hydrocephalus, Ann. Otol. Rhin. & Laryng. **58**:275 (March) 1949.

32. Brunner, H.: Otogenous Edema of the Brain, Ann. Otol. Rhin. & Laryng. **58**:997 (Dec.) 1949.

33. Borries, G. V. T.: Otogenic Non-Purulent Encephalitis, Acta oto-laryng. **37**:483 (Dec.) 1949.

diagnosis. He emphasized the necessity of ruling out brain abscess. The treatment is eradication of the focus in the mastoid and decompression of the brain; usually craniotomy must be performed.

MISCELLANEOUS

Occasional reports of cavernous sinus thrombosis, formerly a deadly disease, are still appearing in the literature.

Pirkey [34] reported a case of cavernous sinus thrombosis in a 40-year-old Negro man, following the opening of a "pimple" on his right cheek. The patient was treated with adequate doses of penicillin, sulfonamide, streptomycin, and heparin, with eventual complete recovery. This case was of special interest, as the patient showed evidence of intracranial bleeding while receiving heparin. He became comatose, paralysis of the right arm and a stiff neck developed, and lumbar puncture revealed 2,160 red blood cells per cubic millimeter. The author pointed out that heparin must be used with caution because of this occasional complication.

Elfman [35] reviewed the anatomy of the cavernous sinus and the pathogenesis of cavernous sinus thrombosis and also classified it. He reported an interesting case of cavernous sinus thrombosis in a 20-year-old diabetic person, secondary to ethmosphenoiditis. The patient was treated with sulfadiazine, penicillin, streptomycin, bishydroxycoumarin, and heparin. The surgical treatment consisted of ethmoidectomy and sphenoidectomy, which were revised later. The patient also required enucleation and a plastic procedure on the upper eyelid later, but the recovery was complete.

Alexander and Reynolds [36] presented a case of a large frontal lobe cerebral abscess which occurred in a child five days after tonsillectomy and adenoidectomy. This case occurred during the poliomyelitis season, was diagnosed as poliomyelitis, and the child died. The authors suggested that perhaps other similar cases have been misdiagnosed as poliomyelitis.

Adson and Uihlein [37] presented an interesting series of 26 patients operated on for cerebrospinal rhinorrhea. The commonest cause of cerebrospinal rhinorrhea is skull fracture which extends through the posterior wall of the frontal sinus or the cribriform plate of the ethmoid bone, with accompanying tears of the dura and arachnoid. Cerebrospinal rhinorrhea frequently has occurred spontaneously as a result of a congenital defect in the cribriform plate which permits extension of an envelope of dura and arachnoid along an olfactory nerve fiber. The thinned-out membrane then may be ruptured by coughing or sneezing. Rhinorrhea also may be found in hydrocephalus and as a result of removal of meningoceles in the nose, which may be mistaken for nasal polyps. Conservative treatment (intranasal cauterization with silver nitrate, etc.) is seldom curative. The authors advocated craniotomy in cases of persistent cerebrospinal rhinorrhea. A bone flap is prepared

34. Pirkey, W. P.: Thrombosis of the Cavernous Sinus, Arch. Otolaryng. **51**:917 (June) 1950.

35. Elfman, L. K.: Thrombosis of the Cavernous Sinus: A New Evaluation and Report of a Case with Recovery, Arch. Otolaryng. **51**:188 (Feb.) 1950.

36. Alexander, S. A., and Reynolds, R.: Abscess of the Brain Following Tonsillectomy and Adenoidectomy: A Case Report, Arch. Otolaryng. **50**:450 (Oct.) 1949.

37. Adson, A., and Uihlein, A.: Repair of Defects in Ethmoid and Frontal Sinuses Resulting in Cerebrospinal Rhinorrhea, Arch. Surg. **58**:623 (May) 1949.

from the frontal bone which extends across the midline so as to uncover the frontal poles of both frontal lobes. The longitudinal sinus is ligated if necessary. The dura is elevated from the frontal fossae until the fistulous tract is encountered. Plastic closure of the tract is then accomplished by overlapping the dura in such a way as to invaginate the meningeal part of the fistula. The tract is closed with No. 0 chromic absorbal surgical suture in continuous suture. The primary suture line is protected by a strip of muscle which is transfixed to the dura and is further reinforced by a second row of interrupted nonabsorbable surgical sutures. The defect in the frontal sinus or cribriform plate is plugged with bone wax. Of the author's 26 cases, 8 were of traumatic origin and 18 were of spontaneous origin. By this surgical method, 22 patients were cured; there were one equivocal result, three failures, and no deaths.

Abstracts from Current Literature

Ear

Special Techniques in Testing the Hearing of Children. William G. Hardy and John E. Bordley, J. Speech & Hearing Disorders **16**:122 (June) 1951.

Hearing tests for infants and young children must be reasonably accurate, descriptively significant, and useful. Most techniques for children do not present this kind of information except in a very mild way. Since 1947, experiments have been under way to develop "ascending" techniques in audiometry together with the Fere effect and a modified form of Pavlovian conditioning. A fairly short burst of the test tone is followed in about three seconds by a mild faradic shock from the inductorium. About 8 to 12 of the combined signals are necessary to set up a conditioned-reflex arc. The shock annoys but does not hurt. Over 650 tests have been done on preschool-age children with skin-resistance responses from infants as young as 3 weeks. Retest data on some of this material show a rather high degree of reliability, although there is a large spread in individual cases.

Palmer, Wichita, Kan.

Studies in Speech Reception Testing. Marcella Peper Doyne and M. D. Steer, J. Speech & Hearing Disorders **16**:132 (June) 1951.

The Voice Communications Laboratory 24-Word Test was investigated as a speech-reception test of hearing ability together with Auditory Test No. 9 (Spondaic Words) and the PB-50 (Phonetically Balanced) lists. Twenty-five normal-hearing subjects and 22 hard of hearing subjects were administered modified forms of the three tests. The Voice Communication Laboratory Test appears to differentiate between persons of normal and of defective hearing.

Palmer, Wichita, Kan.

Michigan's Mobile Hearing Units. Courtney D. Osborn, J. Speech & Hearing Disorders **16**:140 (June) 1951.

Details of construction are given of the Michigan Department of Health Hearing Conservation Unit, a mobile unit which has traveled approximately 30,000 miles in the past three years in all kinds of weather and road conditions. The equipment has proved practical and satisfactory.

Palmer, Wichita, Kan.

Recruitment of Loudness in the Differential Diagnosis of End-Organ and Nerve Fibre Deafness. LeRoy G. Eby and Henry I. Williams, Laryngoscope **61**:400 (May) 1951.

Fowler described a test to differentiate neural from conductive deafness called the "alternate binaural loudness balance." By neural deafness he meant any sort of perceptive deafness. In conductive deafness as the sound intensity was increased the patient heard increasingly better equally in the good and bad ears, while in nerve deafness as the sound was increased he heard relatively better in the poorer ear. The latter phenomenon was referred to as loudness recruitment. Recently some authors observed that this recruitment was present in cases of nerve deafness in which the end-organ was involved but was not present in cases in which the eighth nerve was involved, i. e., tumors and lesions at the cerebellopontine angle. They also noted that there was no recruitment of speech intelligibility in end-organ deafness but there was in eighth nerve deafness. The present paper attempts to throw more light on this problem.

There were 32 cases of unilateral end-organ deafness and 16 of unilateral nerve deafness. Most of the latter were proved by operation. In nerve deafness there was no or very little recruitment found and diplacusis binauralis dysharmonica was absent, while in most end-organ deafness both were present. Speech-intelligibility recruitment was present in the nerve fiber deafness but was absent in the end-organ deafness. Also, the dynamic range for speech was narrower and the threshold of discomfort was lower in end-organ deafness than in nerve fiber deafness. The intensity-difference limen (i. e., the difference of intensity that has to occur for

notice of a change in loudness) remained the same with increased levels of sensation in end-organ deafness and decreased (as in normal ears) in nerve fiber deafness. These differences should better enable the two kinds of deafness to be differentiated. They indicate that discriminative deafness (i. e., the inability to understand speech) is an expression of the same fundamental disorder that produces recruitment.

HITSCHLER, Philadelphia.

THE TENSOR TYMPANI MUSCLE AND ITS INNERVATION. MICHEL PORTMANN, Rev. Laryng. **70**:530 (Nov.) 1949.

Portmann used the new silver-staining methods as found by A. Weber in 1944, combined with the fixation reagent S.W.24. This allows the differentiation of nerve fibers according to their function (autonomic, sensory, motor). The innervation of the tensor muscle follows a definite topographic pattern: the sensory fibers are divided in (1) periosteum (extramuscular) system, (2) intramuscular system, and (3) tendinous and subfascial system. The motor nerve fibers are grouped around the central tendon of the muscle where most of the motor plates are. The autonomic fibers (originating in the otic ganglion) follow the distribution of the motor fibers and terminate in the motor plates. One-fifth of these fibers terminate in autonomic end-organs.

HERSON, Chicago.

THE ROLE OF THE ROUND WINDOW IN THE TRANSMISSION OF SOUND WAVES AFTER LABYRINTHINE FENESTRATION. M. VAN EYCK, Ann. oto-laryng. **67**:777 (Nov.-Dec.) 1950.

In a pigeon in which the ear was abnormal, the columella (the only middle ear ossicle in the bird) was immovable in the oval window, thus producing a spontaneous ankylosis similar to the stapedial ankylosis occurring in otosclerosis in man. Electrophysiological studies of the auditory functions of this pigeon brought some light on the respective functions of the round window and of fenestration in the functional recuperation of the otosclerotic ear.

It was demonstrated that the round window transmits sound waves to the cochlea, while the new window serves solely for the fluid movements of the internal ear.

VIOLE, Los Angeles.

MÉNIÈRE'S ATTACK. HANS BRUNNER, Confinia neurol. **10**:1, 1949.

Brunner believes that the customary concept that the Ménière attack consists of dizziness, deafness, and tinnitus is incomplete. He reasserts the dictum that the genuine Ménière attack is invariably associated with spontaneous nystagmus, usually of a high degree of intensity. He distinguishes four types of Ménière attacks: grand, partial, and abortive attacks and Ménière's equivalents.

The grand attacks are those which consist of "objective and subjective labyrinthine . . . and cochlear symptoms." They may be sufficiently intense to produce loss of consciousness. The partial attacks are those which consist of only labyrinthine or only cochlear symptoms. The author discusses at some length his reasons for accepting the concept of "strictly cochlear attacks," in Ménière's disease. Abortive attacks are those "minor attacks of dizziness or increased tinnitus and deafness which frequently occur and usually do not alarm the patient." Ménière's equivalents are those in which the leading symptom, viz., vertigo, "is not prominent or may even be absent, and is replaced by subjective symptoms of another type, viz., headache or gastro-intestinal symptoms" but always with "nystagmus of the highest intensity."

The author disagrees with those who assert that Ménière's attacks must necessarily cause permanent impairment of hearing. "A patient's hearing may be permanently lost after a few attacks or even after the first noticeable attack or it may be only slightly damaged after a great number of attacks."

FOLEY, Boston [A. M. A. ARCH. NEUROL.].

"OCCULT" MASTOIDITIS. J. BECKER, Med. Klin. **44**:870 (July 8) 1949.

Attention is called again to "occult" mastoiditis in infants with severe acute disorders of nutrition with toxic manifestations for whom examination of the ears does not betray any or only insignificant changes. Early surgical intervention is mandatory.

AMBERG, Rochester, Minn. [A. M. A. J. DIS. CHILD.].

REPORT ON 500 MASTOIDECTOMIES WITH LOCAL PENICILLIN THERAPY. E. GYÖRGY, Paediat. danub. **5**:180 (March-April) 1949.

In 1946, 19 patients with pure otological disease; in 1947, 101, and in 1948, 150 were operated on with use of local penicillin therapy. Thus, the total number of patients with pure otological disease treated in three years was 270. Sixty-one of these patients suffered from a complicated ear process. All the 270 patients recovered.

Further, 241 patients were operated on for ear processes complicated by other conditions. Of these, 104 patients were treated in 1947, 21 of whom (20.1 %) died; in 1948, 137 patients were treated, 10 of whom (7.2%) died. The improvement in the results in 1948 was due to the fact that toxicosis was combated with more success and that streptomycin was also applied.

The total number of the operations was 511. Thirty-one patients died, and 480 recovered. The number of primary healings was 468, or 97%.

FROM THE AUTHOR'S SUMMARY [A. M. A. J. DIS. CHILD.].

IMPAIRMENT OF HEARING IN SCHOOL CHILDREN AND ITS CAUSES. NILS LUNDGREN, Nord. med. **38**:1015 (May 21) 1948.

Among 1,426 Swedish school children examined audiometrically, impairment of hearing for high tones was found in 9.1% and impairment for all tones in 5.1%. None of the former impairments and only 3.1% of the latter were discovered with the ordinary whispering test. Only 0.35% of the children had a loss of hearing great enough to be a serious disadvantage. Twenty per cent of the children had suffered from otitis media. Chronic otitis media was present in 13, three of whom had had cholesteatoma and had been subjected to radical mastoidectomy. In 31.3% adenoidectomy had been performed without any evident influence on the hearing.

WALLGREN, STOCKHOLM, SWEDEN [A. M. A. J. DIS. CHILD.]

Pharynx

CHIPPED GLASS AS A PROBABLE CAUSE OF RETROPHARYNGEAL ABSCESS IN AN INFANT. LYTT I. GARDNER and HORST J. HEINICKE, New England J. Med. **242**:975 (June 22) 1950.

A 10-month-old girl entered Massachusetts General Hospital because of hemoptysis and a swelling in the neck. Two days prior a chip of glass was found to be missing from a baby-soup jar from which the child had been fed. The first bloody vomitus had appeared during a feeding from this jar.

Dysphagia, respiratory obstruction, and high fever marked the course of the illness, but a favorable outcome was gained by virtue of two operative decompressions, chemotherapy, and parenteral alimentations, although the chip was never found. This is the fourth case report involving glass baby-food containers, and the prevention of such accidents is discussed.

WHEELOCK, Denver [A. M. A. J. DIS. CHILD.].

ANESTHESIA FOR TONSILLECTOMY AND ADENOIDECTOMY. H. M. SLATER and C. R. STEPHEN, Canad. M. A. J. **64**:22 (Jan.) 1951.

Slater and Stephen point out the need for careful anesthesia in tonsillectomy. Attention is called to proper premedication and induction to avoid psychic trauma. Ideal anesthesia requires the use of an endotracheal tube. The safest anesthetic agents are a combination of nitrous oxide, oxygen, and ether. Careful watch must be kept for the development of anesthetic complications during and after operation.

MCGUIGAN, Evanston, Ill. [A. M. A. J. DIS. CHILD.].

Larynx

ACUTE LARYNGO-TRACHEO-BRONCHITIS AND ITS MANAGEMENT. HANS VON LEDEN, Illinois M. J. **99**:10 (Jan.) 1951.

During the year 1949, 70 cases of acute laryngotracheobronchitis were seen at St. Francis Hospital, Evanston, Ill., of a total of 2,060 admissions to the pediatric department. This represents more than 3% of the total admissions. Eighty per cent of the tracheotomized patients

were boys. The patients ranged in age from a few months to 14 years, although the ages of 1 to 3 were the commoner ones.

According to Von Leden, results obtained in the treatment of acute laryngotracheobronchitis depend directly on a thorough understanding of the underlying physiological and pathological processes and an application of these principles to the management. Early recognition and hospitalization, good medical supportive care, including the use of a heatless humidity unit, and prompt tracheotomy when surgical intervention is indicated lead to a better prognosis and decrease the mortality for this disease. Eleven consecutive patients with acute, fulminating laryngotracheobronchitis treated by tracheotomy without a mortality prove the value of this management.

BARBOUR, Peoria, Ill. [A. M. A. J. DIS. CHILD.].

FAMILIAL CONGENITAL STRIDOR. HARRY V. L. FINLAY, Arch. Dis. Childhood **24**:223 (Sept.) 1949.

Reference is made to the more important papers illustrating the development of our present knowledge of laryngeal stridor in early infancy. The clinical notes and postmortem findings of three children in one family, all of whom showed congenital stridor, are presented. The last patient was shown to have an abnormal origin and course of the right subclavian artery. Two of the children died shortly after laryngoscopy.

KELLY, Milwaukee [A. M. A. J. DIS. CHILD.].

CONGENITAL STRIDOR DUE TO A DOUBLE ARCH OF THE AORTA. F. EXALTO, Wien. klin. Wchnschr. **42**: 786 (Oct. 20) 1950.

When it is possible to exclude other causes of congenital stridor, such as congenital deformities of epiglottis, larynx, and trachea, pressure by tuberculous lymph nodes on trachea or bronchus, mediastinal tumors of cysts, or hyperplastic thymus (mostly wrong), it is necessary to think of vascular abnormalities. The stridor may be inspiratory or expiratory or both, it need not be constant, it may be evoked by excitation. A typical chronic cough is noted. Crying is hoarse. Very important for the diagnosis of a constricting vascular ring are dyspnea during food intake, often with cyanosis, and vomiting. Roentgenologic examination of the esophagus and occasionally of the trachea with barium and iodized oil may decide the diagnosis. The author operated, within a few months, on three children 5, 5½, and 10 months of age for whom the diagnosis was confirmed on operation. Some difficulties encountered on operation are discussed.

AMBERG, Rochester, Minn. [A. M. A. J. DIS. CHILD.].

Nose

MAXILLARY SINUSITIS IN CHILDREN—A TREATMENT TECHNIQUE. R. H. VON DER BORCH, Clin. Rep. Adelaide Child. Hosp. **1**:216 (May) 1949.

Von der Borch describes his method of treating maxillary sinusitis by lavage through indwelling tubes in the antrums.

MCGUIGAN, Evanston, Ill. [A. M. A. J. DIS. CHILD.].

PER-PRIMAM-HEALED ANTROTOMIES TREATED WITH PENICILLIN ONLY LOCALLY IN INFANCY AND CHILDHOOD. D. KOLLÁR, Orvosok lapja **4**:1257 (Sept. 26) 1948.

According to the experiences of Kollár, per primam healing in antrotomies can be attained when the operative cavity is filled with penicillin in gelatin and the soft tissues are connected over it. When the antrotomy is complicated by pyemia or dehydration, besides the local application of penicillin, intramuscular treatment is also necessary.

GÖRGÉNYI-GÖTTCHE, Budapest, Hungary [A. M. A. J. DIS. CHILD.].

SINUSITIS IN CHILDREN AT HOME AND IN DAY-NURSERIES. GUNNAR BJUGGREN, SVEN KRAEPELIEN and JOHN LIND, Ann. pædiat. **173**:205 (Oct.) 1949.

This investigation was designed to compare the data on incidence, nature, and duration of sinus affections in ordinary "healthy" children between the ages of 3 and 6 years who live at home and in comparative children who are looked after in day nurseries. The material was

composed of 74 children in all. Half the children were day-nursery children and the other half home children, and the latter were socially equal to the nursery children. In addition to clinical roentgenological examination of the maxillary sinus, sedimentation rate, and the proportion of the antistreptolysin titers were observed. In a number of cases, as a control of the roentgenogram findings, antrum puncture was performed, and examination of the product of the irrigation was made with regard to cells and bacteria. All the children were examined on three different occasions at intervals of two months during the period of October, 1947 to May, 1948. The following results were obtained.

1. Under the prevailing conditions sinus affection is a common phenomenon, even in so-called healthy children between the ages of 3 and 6 years. About half of the children examined presented pathological antrum changes, in many cases in the form of high-grade roentgenological changes and positive results of antrum irrigation. Good agreement was found between the antrum changes shown on roentgenograms and the results of the irrigations, for both positive and negative findings. In a supplementary examination of 80 children (34 home children and 46 day-nursery children, chosen on the same principles) the incidence of antrum changes was verified.

2. Sinus affection was often present without the child otherwise showing any symptoms of infection of the upper air passages.

3. In the authors' material no sure distinction could be made between the two categories of children concerning the incidence of sinus affections at one examination. However, an analysis of the results of the repeated examinations indicates that the sinus affections in a majority of the day-nursery children were more protracted than in home children. There was a preponderance of the most pronounced sinus changes in day-nursery children over home children.

4. Children with these sinus affections showed in relatively very few cases increased sedimentation rate or increased antistreptolysin titer.

FROM THE AUTHORS' SUMMARY [A. M. A. J. DIS. CHILD.].

Miscellaneous

ANTIHISTAMINIC AGENTS AND ASCORBIC ACID IN THE EARLY TREATMENT OF THE COMMON COLD. D. W. COWAN and H. S. DIEHL, J. A. M. A. **143**:421 (June 3) 1950.

Cowan and Diehl review some of the work that has been previously accomplished in the treatment of the common cold and outline their present study. They have conducted a controlled experiment to evaluate the value of the antihistaminic agents and, in addition, large doses of ascorbic acid. The subjects were University of Minnesota students who volunteered to join the group because they were especially susceptible to colds and because colds constituted a real problem to them.

The authors give the following summary: "Under the conditions of this controlled study, in which 980 colds were treated in 367 supposedly nonallergic students, there is no indication that ascorbic acid alone, phenindamine tartrate (thephorin®) alone, ascorbic acid plus phenindamine, or tripelennamine (pyribenzamine®) hydrochloride have any important effect on the duration or severity of these infections of the upper respiratory tract." GORDON, Philadelphia.

SOME PROBLEMS OF THE COMMON COLD. A. L. BLOOMFIELD, J. A. M. A. **144**:287 (Sept. 23) 1950.

Bloomfield discusses in detail the clinical features of the common cold, after which he outlines the etiology, epidemiology, diagnosis, prophylaxis, and treatment. His bibliography consists of 62 references, and any reader will see at once that he has delved deeply in this subject. The field covered is vast, and the concepts are complex. He summarizes and concludes as follows: "The common cold is a specific virus infection which may be thwarted by resistance of the host or promoted under some conditions by exposure to cold or by other influences. Infection may come from without, from a patient or perhaps from a carrier. . . . There is no solid evidence that the true cold is influenced by antihistaminics or antibiotics, nor is there any reliable method of prevention. Treatment remains symptomatic—rest, safeguarding, local applications and general sedatives. The true cold is often confused with the various forms of traumatic rhinitis, . . . which may be amenable to various forms of suitable therapy, such as antihistaminic or antibiotic therapy. . . . .

"Since this paper was written several carefully controlled studies of the effects of antihistaminics in colds have appeared. In some no difference could be detected between the effects of the drug and a placebo. . . ."

GORDON, Philadelphia.

MODERN TRENDS OF SURGERY AND TREATMENT IN OTOLARYNGOLOGY. W. H. JOHNSTON, J. A. M. A. **144**:977 (Nov. 18) 1950.

Johnston has spent almost 40 years practicing otolaryngology and briefly reviews some of the concepts from the turn of the century up to the present time. The discoveries and advances in general medicine have modified otolaryngological practice. Antibiotic therapy has changed the course of many respiratory infections. The need for sinus surgery has been reduced. The pendulum has swung toward conservative treatment.

Johnston does not believe that a nonfunctioning, infected lining of a nasal sinus can be restored to normal by either antibiotics or chemotherapy. He feels that focal infection is still an important causative factor in systemic disease. Allergy is important, though the methods of desensitization do not always offer a solution. Antihistaminic drugs are in general use, and some satisfactory results have been reported.

He discusses the methods of procedure in bronchoesophagoscopy and the use of radium applicators for treatment of excessive lymphoid tissue blocking the Eustachian tube. He is rightly critical of the latter. His otological discussion concerns itself with the fenestration operation for clinical otosclerosis, with a plea that a more careful selection be made of patients for the operation.

He concludes the article with a discussion of otitis media with effusion, as was recently reemphasized by G. D. Hoople.

GORDON, Philadelphia.

COMPLICATED FRACTURES OF THE MAXILLA. D. L. MURPHY, E. S. MURPHY, and W. A. MCNICHOLS, J. A. M. A. **145**:614 (March 3) 1951.

The types of injuries that are met with in the current high rate of accidents are enumerated and methods of obtaining an accurate diagnosis outlined. The authors discuss fractures of the maxilla and of the mandible, include several roentgenograms, and conclude as follows: "1. Each locality should have a group of physicians who are willing to care for maxillofacial injuries. 2. In fractures of the maxilla, prompt reduction gives best results. External fixation and extension, as shown . . . . is most satisfactory in regard to comfort to the patient and absolute fixation of the fragments. 3. External fixation of fractures of the mandible can be used for almost any fracture. We are opposed to any type of open operation."

GORDON, Philadelphia.

THE BROADENED SCOPE OF OTOLARYNGOLOGY. FRANCIS L. LEDERER, J. Internat. Coll. Surgeons **13**:597 (May) 1950.

Lederer traces some of the ideas of the earlier clinicians and surgeons which led to otolaryngology as a specialty. He points out that this specialty has kept faith and pace with the general advances in medicine and surgery. He discusses in moderate detail the value of a basic course for anyone contemplating the specialty, followed by a residency in an approved hospital, and he augments these points with an outline of the hours devoted to this intensive study at the University of Illinois. All available resources have been pooled in Chicago, where three- to five-year residency training is provided utilizing the joint and reciprocal facilities of hospitals and medical schools.

The specialty has broadened and will continue to broaden even as medicine and surgery have. This requires first-class teaching hospitals with constant guidance and adequate supervision.

GORDON, Philadelphia.

CLINICAL OBSERVATIONS ON TERRAMYCIN IN PEDIATRIC INFECTIONS. T. G. POTTERFIELD and G. A. STARKWEATHER, J. Philadelphia Gen. Hosp. **2**:6 (Jan.) 1951.

Potterfield and Starkweather studied the results of terramycin therapy in 62 children, of which number six had otitis media, four tonsillitis, one sinusitis, and one laryngotracheobronchitis. It was found that terramycin is an effective therapeutic agent in respiratory infections due to

Diplococcus pneumoniae, Micrococcus pyogenes (Staphylococcus) variety aureus, Hemophilus influenza, and beta hemolytic streptococci. All the patients with otitis media had fever on admission to the hospital (ranging between 102 and 105 F.). Within 24 to 48 hours after terramycin therapy was started, their temperature returned to normal. One child required a myringotomy. The four patients with tonsillitis became afebrile in 48 hours. Cultures grown from material from the throat revealed hemolytic Streptococcus in three and beta hemolytic Streptococcus in one. A 7-month-old patient had laryngotracheobronchitis but became afebrile in 48 hours, after terramycin therapy was begun. The general clinical picture of this child improved satisfactorily after the third day. One 6-year-old patient with maxillary and ethmoid sinusitis showed marked clinical improvement 24 hours after terramycin therapy was started and became afebrile in 48 hours. The other children in this series had pneumonia. In this group of 62 children, no toxic manifestations were observed, and the authors felt that terramycin was effective in the treatment of the common bacterial respiratory tract infections of children.

GORDON, Philadelphia.

MIGRAINE HEADACHE: AN ANALYSIS OF 124 CASES TREATED BY HEAD-TRACTION MANIPULATION AND THIAMIN CHLORIDE. MURRAY M. BRAAF, New York J. Med. **51**:528 (Feb. 15) 1951.

Emphasis is placed on trauma to the cervical spine as a cause of severe headache. Other factors are injuries to the neck of an indirect nature, such as carrying heavy baggage. Heredity and allergy also play a part, and the influence of miscellaneous factors such as emotional upsets, watching motion pictures and television, exposure to the sun, coughing and sneezing, and irrition from acid fumes or the smoke in ill-ventilated rooms may be noted. Definite, localized spots of tenderness can often be found along the cervical spine, on the same side as the head pains. At times pressure on such spots seems to produce an attack of cephalalgia. Each patient should be given a complete physical examination, including blood, urine, and Wassermann studies, and eyes and nasal sinuses should receive special attention. A neurological survey is imperative. The history, especially family history, is important.

Thiamin hydrochloride given intramuscularly helped in some 65% of the patients studied, and estrogenic therapy was also employed. Procaine hydrochloride in a 2% solution injected into certain areas gave relief. Head traction and manipulation were used as routine measures. The most outstanding finding was localized tenderness in the upper cervical spine in both typical and atypical forms of migraine—a sort of hidden localized neuritis which sometimes was quite unknown to the patient.

VOORHEES, New York.

SUPPURATION OF THE SALIVARY GLANDS IN THE NEWBORN. I. NEWTON KUGELMASS, New York J. Med. **51**:613 (March 1) 1951.

Kugelmass states that infection of the salivary glands in newborn infants is not so rare as it is thought to be, and cites five references in the literature to prove it. In all five cases reported by him the weight of the infant at birth was from 3 pounds (1,360.8 gm.) plus to 5 pounds (2,268 gm.) plus. In each instance the physique was frail, and the body was "overrun with the Staphylococcus aureus in the nasopharynx." Infection was, in each instance, traceable to the mother in whom there was folliculitis or furunculosis, acne, or some other communicable germ of the Staphylococcus family. It is interesting to note that sulfathiazole failed to prevent suppuration. Penicillin controlled the infection, but the best results were obtained with a combination of penicillin and chloramphenicol (chloromycetin®). The observations extended over a six-year period. The blood showed a leucocyte count of up to 40,000 per cubic millimeter. The neutrophil count was high—up to 80%. Toward the end of the first week there was unexplained fever, followed by swelling of the parotid or submaxillary glands on one or both sides of the neck. Incision was not required in every case, especially if the antibiotics used were immediately active. Meticulous general care as to feeding, etc., was carried out with excellent results.

VOORHEES, New York.

REVERSIBILITY OF EARLY BRONCHIECTASIS: ITS IMPLICATIONS FOR THERAPY AND PREVENTION. WALTER FINKE, New York J. Med. **51**:1163 (May 1) 1951.

The study was made in the Chest Clinic of the Genesee Hospital, Rochester, N. Y. Finke states that many so-called chronic bronchiectases are reversible and may be relieved without surgery even after three or four years' duration. Postmortem reports bear this out. However,

so far we have no reliable criteria to differentiate between transient and permanent ectasia. Surgery sometimes proves insufficient, since the condition may be multilobular and bilateral. Therefore, medical management should be carried to the utmost before surgery is attempted. Postural drainage, the antibiotics, potassium iodide, epinephrine, and aminophylline are important measures. We should not allow potentially chronic infections of the bronchi to become permanent. Effective treatment of the various types of pneumonia is stressed. "Viral pneumonias" may be of tuberculous origin. Unresolved pneumonias may set the pattern for bronchiectasis. Prevention of bronchiectasis should be our ultimate aim. Direct bronchoscopy, plus adequate medication locally in the bronchi and systemically, is mentioned in this connection. A table sets forth results of antibiotic therapy in 168 patients followed for two years or more. There are 54 references to the literature, including five papers describing Finke's experiences.

VOORHEES, New York.

PENICILLIN AND ITS EFFECT IN PRODUCING A PREDOMINANT GRAM-NEGATIVE BACILLARY FLORA IN UPPER RESPIRATORY TRACT OF CHILDREN. FREDERICK D. HAFFNER, ERWIN NETER, and MITCHELL I. RUBIN, Pediatrics **6**:262 (Aug.) 1950.

A study was carried out on 90 children to determine whether conversion to a gram-negative bacillary flora of the nasopharynx and throat takes place during therapy with penicillin, either alone or in conjunction with sulfonamides, and to evaluate the influence of such a conversion on the course of the infection.

After the demonstration of "conversion" in 22 selected cases, a change to a gram-negative bacillary flora was observed in 30 of 68 unselected children. The gram-negative bacilli encountered in this conversion group included members of the Escherichia coli-Aerobacter aerogenes group, Pseudomonas aeruginosa, Alcaligenes fecalis, and Klebsiella pneumoniae; these organisms became predominant in 23 of the 30 children. In 22 the gram-negative bacillary flora was present prior to commencement of specific therapy, but the number of these organisms increased in 13 instances. Such a conversion did not take place in 16 children.

Vomiting per se was not responsible for the conversion, since it occurred more frequently in the nonconverted group, and vomiting was not a prominent feature of the converted patients. Of 10 patients receiving penicillin aerosol, in nine there was conversion to a predominantly Gram-negative bacillary flora. The administration of sulfonamides in conjunction with penicillin did not materially lower the incidence of conversion. Clinical evaluation of the patients showed that on the average the children with conversion had a severer illness and one of longer duration than those of the nonconversion group.

Five patients of this group, all under 2 years of age, died. Autopsy was performed on four and revealed the presence of Gram-negative bacilli in the lung tissue of three of them. This was considered indicative of the potential pathogenicity of this group of micro-organisms when they invade the respiratory tract.

The significance of these data is discussed.

FROM THE AUTHORS' SUMMARY.

REFLUX ESOPHAGITIS, SLIDING HIATAL HERNIA AND THE ANATOMY OF REPAIR. P. R. ALLISON, Surg., Gynec. & Obst. **92**:419 (April) 1951.

Hernias through the diaphragmatic hiatus are of two main types, the paraesophageal, or rolling, and the sliding. Allison analyzes these two forms of hernia with respect to embryologic and anatomic considerations of peritoneal reflection, muscular constituents of the hiatus, symptomatology, endoscopic findings, and surgical repair. He stresses the fact that with a sliding hernia it is the irritation of the esophagus which produces symptoms and that ulceration, when it occurs, is dependent upon the anatomic derangement of the cardia. He proposes the application of Cushing clips to the cardia through the esophagoscope and the taking of roentgenograms to show the movement of the viscus in the preoperative study of these patients. Congenitally short esophagus is considered by Allison to be a great rarity. A syndrome of heartburn, gastric flatulence, and postural regurgitation is described and is attributed to reflux esophagitis. The results of operative treatment in 33 patients with sliding hiatal hernia and superficial esophagitis are presented, along with the results in 15 patients who had stenosis which required resection.

FRIEDBERG, Chicago.

CONGENITAL ATRESIA OF OESOPHAGUS. R. H. R. BELSEY and C. P. DONNISON, Brit. M. J. **2**:324 (Aug. 5) 1950.

In 1947 Franklin, in *Lancet*, mentioned that congenital atresia of the esophagus occurred in 1 in 2,500 births. Belsey and Donnison, however, report that in their experience the incidence is much greater than that, being about 1 in 800 deliveries. They state that a number of cases are not diagnosed and that deaths which are due to this condition are attributed to other causes; it is their belief that this condition is even commoner than the above-mentioned figure.

The diagnosis is easy to make if the condition is suspected, and an early sign is the infant's bringing up large amounts of frothy mucus. It is pointed out that it is important that these children should not be fed by mouth until this condition has been excluded. The diagnosis is easily made by the passage of a rubber catheter into the stomach and can be confirmed by roentgenologic studies with a contrast medium.

These authors report 10 patients who were treated by operation; five patients survived. The transpleural approach was used in all five of the successfully treated patients. It is also stated by the authors that feeding by mouth can be resumed 24 hours after operation or earlier and that a gastrostomy appears to be unnecessary in the uncomplicated cases.

BIRDSONG, Charlottesville, Va.

WHAT THE PRACTICAL PHYSICIAN SHOULD KNOW ABOUT ESOPHAGEAL PATHOLOGY. JULIO C. BARANI, An. oto-rino-laring. Uruguay **20**:67, 1950.

Barani outlines the commonest pathological conditions of the esophagus. To make a diagnosis, it is essential to have taken a careful clinical history, which in 90% of the cases will establish the diagnosis, to have made roentgenologic studies, and to have done an esophagoscopy.

He discusses the following conditions:

1. Atresia is the commonest congenital anomaly. The symptoms in a newborn infant are profuse secretions in the mouth and nose and regurgitation of milk. Occasionally there is cyanosis due to spasm of the larynx when some of the regurgitated milk enters into the larynx. The diagnosis is established by the finding of an obstruction at a distance of 8 to 10 cm. on passage of a fine Nélaton sound into the esophagus. Iodized oil (lipiodol®) may be instilled through the catheter and roentgenologic studies made. The treatment is formation of an anastomosis between the two ends of the esophagus.

2. Congenital stenosis is indicated by the easy passage of fluids into the stomach but causing of dysphagia by semisolids or solids. The commonest site for stenosis is at the bifurcation of the trachea. The treatment is by dilatation.

3. Diverticulosis of the pharynx is due to herniation of the mucosa and submucous layer. When the sac is small it usually is in the midline, but when large it forms a swelling in the neck. The symptoms are dysphagia and regurgitation of the food. The treatment is external extirpation of the sac. Diverticulosis of the esophagus is usually due to traction. It is rare and usually involves the tracheal portion of the esophagus. Epiphrenal diverticulosis is found in the region of the diaphragm. Treatment is both by thoracotomy and by fixation of the superior poll of the sac to the wall of the esophagus.

4. Cicatricial stenosis is usually due to caustics. Treatment depends on how soon the patient is seen after the ingestion of the caustics and consists of neutralization of the caustics: treatment of shock, dehydration, and acidosis, and later dilatation.

5. Foreign bodies are found most frequently in children. They are easily seen on roentgenologic study and are either passed or removed by esophagoscopy.

6. Complications from foreign bodies are most commonly due to the swallowing of fish bones, which may cause retropharyngoesophageal abscess. Such an abscess can be opened by esophagoscopy.

7. Esophagitis in most cases is nonspecific inflammation of the esophagus caused by many factors. When the symptoms are so severe that the patient cannot swallow liquids, a gastrostomy is indicated and with a subsidence of the acute symptoms, early institution of dilatation. It is extremely important not to permit the closure of the esophagus.

8. Infantile megaloesophagus is usually diagnosed by roentgenologic studies. Although there is rarely any frank obstruction at the lower end of the esophagus to cause the condition, dilation of the esophagus by means of a mercury bougie is the method of treatment, and spectacular cures can be obtained.

9. Megaloesophagus in adults is usually secondary, and one of the commonest symptoms is cardiospasm. The treatment is by dilatation either by air balloons or by mercury sounds.

10. Varices are indicated primarily by frequent hemorrhages. At times they may be fatal. They are due to circulatory disturbances, such as cirrhosis of the liver, disturbances of splenic circulation, or Banti's disease.

11. Compression is caused by extrinsic factors, such as tumors of the mediastinum, anomalies of the aorta, and aneurysm.

12. In hiatal hernia roentgenologic examination aids in the diagnosis. The symptoms may be minimal or, on the other hand, so diverse as to be extremely confusing. When the hernia is large, surgery may help.

13. Cancer of the pharynx can be readily diagnosed by early roentgenologic examination. Cancer can occur at any age. When it is operable, surgery should be done with a resection of the lesion and an anastomosis of the upper end of the esophagus; when inoperable, a gastrostomy is indicated to permit the taking of food.

PERSKY, Philadelphia.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Sherman L. Shapiro, M.D., *President*
Lawrence J. Lawson, M.D., *Secretary-Treasurer*
March 5, 1951

A New Technic of Hemostasis in Otolaryngology Using Gelfoam® Powder. Dr. Myron Hipskind.

Control of bleeding is one of the most challenging problems encountered by the otolaryngologist. Technical difficulties peculiar to this field of surgery and to the treatment of diseases of the ear, nose, and throat frequently preclude the use of sutures and ligatures. Hemostasis obtained by the application of pressure and by the use of packs is not commonly practical or feasible.

Bleeding from ruptured or traumatized telangiectatic vessels in Kiesselbach's area is controlled easily by coagulation of the point of hemorrhage with a chromic acid bead or live cautery. The success of the procedure is dependent upon direct visualization of the area and the application of the cauterizing agent in a dry field. Epistaxis secondary to liver disease associated with either hypoprothrombinemia or vitamin K deficiency or both presents a more vexing problem. It is difficult to obtain a dry field in these cases. Bleeding is active and persistent. Should spontaneous arrest occur, the exact point of hemorrhage is not easily identified. Recurrence of bleeding is certain. The point of bleeding in these cases is most commonly located in the middle or posterior one-third of the nose. Direct inspection and treatment is not possible.

During the winter months, the incidence of epistaxis is increased. This is thought to be the result of excessive drying of the nasal mucosa by overheated dry homes and offices. Again, in these cases there is oftenest bleeding from the deeper nasal chamber areas. Similar bleeding is usually seen in hypertensive epistaxis.

Bleeding following the removal of the packing is the primary indication for development of a method that overcomes this unpleasant incident in the postoperative course of patients after polypectomy. Bleeding and discomfort of the patients, at the time of removal of packing from the maxillary antrum leaves much to be desired in postoperative management of those with radical sinus surgery. Occasionally bleeding after complete and carefully executed adenoidectomy will occur. At this time the surgeon earnestly desires a more direct and simple form of hemostasis than the postnasal tampon now in vogue. The removal of aural polyps, granulation tissue, and cholesteatomatous material from the middle ear region is commonly associated with annoying bleeding. Packing is contraindicated. Surgery of the temporal bone is frequently complicated by unexpected and troublesome bleeding. The inadvisability of controlling this type of bleeding with packs, bone wax, and muscle is obvious.

The absorbable gelatin sponge (gelfoam®) "patch" and the insufflation of absorbable gelatin sponge powder have been helpful in the clinical management of all these conditions. The gelatin sponge is prepared from ordinary commercial gelatin. Air is introduced into gelatin solution to obtain the desired porosity, and the gelatin is heated in an oven until dry. A crisp white material is thus obtained which can be cut or powdered into any desired size. It is packaged in glass jars, which are subjected to dry heat sterilization at 290 F. before being sealed. The gelatin sponge is capable of absorbing 50 times its weight of water or 45 times its weight of blood. It is nonantigenic and nonpyrogenic.

My interest in the application of the method in the field of otolaryngology followed the motion-picture demonstration of control of hemorrhage by a gelatin sponge shown by Dr. H. P.

Jenkins at the convention of the American Medical Association in 1946. The patch technique for the control of epistaxis formed the basis for a report made by Cope and me the following year.

The difficulties experienced in introduction of the absorbable gelatin sponge patch into the deeper areas of the nasal chamber were multiple. Commonly the pack would be dislodged or become displaced in the process of withdrawing the forceps. Since the use of the powdered form of absorbable gelatin sponge, we have in part surmounted this problem. The motion picture demonstrates the equipment, the material, and the method now employed. Many problems must be worked out before the desired objective can be reached. We are now engaged in the construction of an insufflator which offers promise.

It should be emphasized that the use of these absorbable hemostatic agents is not a substitute for ligature or suture in the ordinary routine techniques of operative surgery. The particular field of usefulness for these new materials is in cases in which the ligature or suture is not adequate or feasible.

DISCUSSION

DR. SAMUEL SALINGER: During the past winter we have seen a number of cases of nasal hemorrhage in elderly patients with hypertension in which repeated packing, left in the nose for as long as seven days, frequently failed. I wonder if Dr. Hipskind has had any experience with his procedure in this type of case.

The simple bleeding from Kiesselbach's area is not a problem. Our difficulties arise in those cases in which severe bleeding prevents one from visualizing and locating the bleeding vessel. It is easy enough to say "locate the bleeding point and apply the cautery," but in actual practice this is frequently impossible because of the profuse bleeding and the inaccessibility of the vessel.

DR. O. E. VAN ALYEA: Is this advocated for post-tonsillectomy bleeding and as an immediate procedure following operation, and does Dr. Hipskind think the method aids healing?

DR. MYRON HIPSKIND: Dr. Wojniak asked concerning necrosis of the tissues after the use of absorbable gelatin sponge. The absorbable gelatin sponge patch itself becomes a very pliable and elastic tissue that has been demonstrated to be absorbed in a sterile field in four to six weeks. At the end of the first week the patch is easily identifiable but as weeks go by it is absorbed, so there is no possible way for it to become a pressure factor; it becomes part of the tissue. Abundant work has been done by Jenkins and his group to show that if the patch holds for 10 minutes to 1 hour in the abdomen it can be expected to continue to control hemorrhage. Hemorrhage in large wounds has even been continuously controlled. As the patch becomes directly associated with the point of bleeding, the tissue and the patch become, as it were, "one structure." However, should a clot form between the site of hemorrhage and the patch, a blow-out usually occurs.

Dr. Lewy asked about excessive nasal hemorrhage. As Dr. Salinger stated, it is quite erroneous and of dubious security to think that if you can see the vessel all you need to do is to cauterize it. Bleeding from Kiesselbach's area is easily controlled, but the bleeding we are concerned with is that which continues to recur in spite of application of packing and leaving the packing in for a long time. In these cases there is usually associated alcoholism, liver disease, or hypoprothrombinemia. We have used this technique in a case of persistent bleeding associated with liver disease. The bleeding could be seen, but we were unable to control it with the usual methods. On the insufflation of absorable gelatin sponge powder, the bleeding was controlled. We have presented this film on the laboratory animal only to demonstrate the ability of the powder to control bleeding.

In answer to Dr. Van Alyea, we have used both the powder and the patch in tonsillectomy. They have been without value. On one occasion the powder was insufflated into a persistently bleeding adenoid and the bleeding stopped. It is assumed that it was the agent that controlled the bleeding, although this must remain in the realm of assumption.

Mixed Tumor of the Inferior Turbinates: Subsequent Course of a Case Previously Reported. DR. SAMUEL SALINGER.

In June, 1949, I reported an unusual tumor of the inferior turbinate (*Ann. Otol., Rhin. & Laryng.* **58**:485 [June] 1940) about which there was some difference of opinion as to its proper classification. It was originally termed an adamantinoma or ameloblastoma and later designated

as a mixed tumor in the opinion of the Army Institute of Pathology, to which a slide had been submitted. At that time I stated that although the healing was complete I feared the possibility of recurrence which, in this type of growth, is not infrequent.

My premonition was not unfounded. About 12 months later the patient reappeared complaining of recurrence of nasal bleeding, and on examination a spongy friable mass filling the inferior meatus on the side previously operated on was found. Roentgenograms failed to show involvement of the bony nasoantral wall or the maxillary sinus. Nevertheless, with the previous history in mind and being aware of the tendency for these growths to recur, I decided on radical exenteration. A Denker operation was performed, and the entire nasoantral wall, including the inferior and middle turbinates, as well as the lining of the maxillary sinus, was removed. This was followed by an extensive course of irradiation. Recovery was complete, and today (about 18 months later) the antrum, which is readily visible by anterior rhinoscopy, is perfectly smooth and clear.

Histological study of the excised tissue revealed substantially the same sort of structure as in the original specimens. Masses of basal-like cells are seen arranged at times in columns and groups separated by typical fibrous meshwork. In some areas a more differentiated type of epithelial cell is seen arranged in rows, at right angles to the mass of basal cells.

To understand the genesis and morphology of a tumor of this sort, it is important to bear in mind that the primitive buccal epithelium of the first branchial cleft subsequently differentiates into six different types of epithelium, namely, squamous cells, mucous glands, salivary tissue, enamel organ, thyroid tissue, and Rathke's pouch. This has been most clearly explained by Ward and Hendrick in their excellent treatise "Diagnosis and Treatment of Tumors of the Head and Neck" (Baltimore, Williams & Wilkins Company, 1950, p. 305). Knowing this, it is not too difficult to explain late development of rests of the primitive epithelium in areas remote from the sites where they normally belong. This also explains the appearance of thyroid and salivary tissue in the nasal and pharyngeal cavities. The reason why it is difficult at times to name accurately a particular growth or give it an exact designation is that the cells comprising the body of the growth have not differentiated sufficiently to become typical of this, that, or the other organ. Unless the morphology approximates that of the enamel organ, the thyroid, or the salivary apparatus, one is not justified in calling the tumor an adamantinoma, a thyroid rest, or a salivary gland tumor. As a matter of fact, one would be justified in calling the undifferentiated tumor comprised chiefly of basal cells, as in the case herewith reported, a basiloma, which it simulates very closely. Certainly this tumor does not exhibit the characteristic histological picture of adamantinoma, since stellate cells are nowhere to be seen and the stroma fails to show the hyaline substance which is the forerunner of an enamel substance. On the other hand, the presence of different types of epithelial cells, at times in eccentric arrangements with suggestion of glandular elements here and there, would impel one to call it a mixed tumor, which was the diagnosis given by the Army Institute of Pathology.

However, in the final analysis, it is not the terminology that is so important. What really matters is whether the tumor is benign or malignant. Experience has shown that all these tumors, whether we call them adamantinoma, basiloma, mixed tumor, or what not, though primarily benign, are prone to recur locally and infiltrate adjacent tissues causing extensive destruction and ultimately becoming malignant. In one case of adamantinoma of the maxilla in which the patient was followed for five years postoperatively without evidence of recurrence, the tumor turned up after eight years with an extensive growth of the same character in almost the same location. The lesson to be learned, therefore, is that any atypical growth about the oral cavity that exhibits histologically embryonic cells should be dealt with in a radical manner. The excision should be wide enough to insure complete removal into definitely healthy areas. Experience with mixed tumors of the parotid gland and adamantinomas of the maxilla amply supports this contention.

DISCUSSION

DR. JOSEPH G. SCHOOLMAN: In clinical oncology we do not differentiate too closely between the pathologic terminology of benign and malignant, because we find that pathologically benign lesions are often clinically malignant. For that reason we would like to see the Denker operation placed in the same category as simple mastectomy—a procedure no longer performed. We think the procedure gives too little postoperative view of the area to allow adequate follow-up of these

people, and too often there is a recurrence which is at too advanced a stage to cope with before it becomes evident by examination through the small opening allowed by the Denker operation. We feel that in these cases there should be at least a subtotal resection of the maxilla; the hard palate and the superior alveolar ridge should be resected so that the entire area is in view. The prostheses are now available to keep such a procedure from being deforming or an inhibiting factor in surgical approach. We feel that adequate exposure of the area is the only way to prevent malignant lesions from getting beyond us and benign lesions or pathologically benign lesions from becoming clinically malignant.

DR. SAMUEL SALINGER: I think Dr. Schoolman's point is well taken. It depends a good deal on the site of the growth. I agree that many times lesions are pathologically not malignant, yet clinically behave as malignant growths. In a case such as ours, in which the lesion involved only the inferior turbinate, the Denker procedure exposes not only the floor of the nose but the antrum cavity as well. There is no question but that wide exposure is desirable in any case.

We have a patient now with a growth on the septum, a fungating bleeding lesion, and are prepared to do a radical operation if the frozen section proves it to be malignant. It goes without saying that the extent of the surgery depends on the type of the lesion as well as its extent.

Special Reports

HEARING AIDS ACCEPTED BY THE COUNCIL ON PHYSICAL MEDICINE AND REHABILITATION OF THE AMERICAN MEDICAL ASSOCIATION

As of Nov. 1, 1951

Audicon Models 400 and 415

Mfr., National Earphone Co., Inc.
20 Shipman St.
Newark 2, N. J.

Audivox Model Super 67

Mfr., Audivox, Inc.—Successor to Western Electric Hearing Aid Division
259 W. 14th St.
New York 11

Aurex Model F

Aurex Model H

Mfr., Aurex Corporation
1117 N. Franklin St.
Chicago 10

Beltone Harmony Mono-Pac

Beltone Symphonette Model

Beltone Mono-Pac Model M

Mfr., Beltone Hearing Aid Company
1450 W. 19th St.
Chicago 8

Cleartone Model 500

Cleartone Regency Model

Mfr., American Sound Products, Inc.
1303 S. Michigan Ave.
Chicago 5

Dahlberg Model D-1

Mfr., The Dahlberg Company
2730 W. Lake St.
Minneapolis 16

Dysonic Model 1

Mfr., Dynamic Hearing Aids, Inc.
1042 Atlantic Ave.
Brooklyn 16

Electrotear Model C

Mfr., American Earphone Co., Inc.
10 E. 43rd St.
New York 17

Gem Model V-35

Gem Model V-60

Mfr., The Gem Ear Phone Co., Inc.
50 W. 29th St.
New York 1

Maico Atomeer

Maico UE Atomeer

Maico Quiet Ear Models G and H

Maico Model J

Mfr., The Maico Company, Inc.
21 N. 3rd St.
Minneapolis 1

Mears (Crystal and Magnetic) Aurophone Model 200

1947-Mears Aurophone Model 98

Mfr., Mears Radio Hearing Device Corp.
1 W. 34th St.
New York 1

Micronic (Magnetic Receiver) Model 101

Micronic Model 303

Micronic Star Model

Mfr., Micronic Company
727 Atlantic Ave.
Boston 11

(See Silver Micronic)

Microtone Audiomatic T-5

Microtone Classic Model T-9

Microtone Model T-10

Microtone Model 45

Mfr., The Microtone Company
Ford Parkway on the Mississippi
St. Paul 1

National Cub Model (C)

National Model D (Duplex)

National Standard Model (T)

National Star Model (S)

National Ultrathin Model 504

National Vanity Model 506
Mfr., National Hearing Aid Laboratories
815 S. Hill St.
Los Angeles 14

Otarion Model E-4

Otarion Models F-1, F-2, and F-3

Otarion Model G-2
Mfr., Otarion, Inc.
159 N. Dearborn St.
Chicago 1

Paravox Model J (Tiny-Myte)

Paravox Model XT ('Xtra-Thin)

Paravox Model XTS ('Xtra-Thin)

Paravox Model Y (YM, YC, and YC-7) (Veri-Small)
Mfr., Paravox, Inc.
2056 E. 4th St.
Cleveland 15

Radioear Permo-Magnetic (Multipower)

Radioear Permo-Magnetic (Uniphone)

Radioear All-Magnetic Model 55

Radioear Model 62 Starlet

Radioear Model 72
Mfr., E. A. Myers & Sons
306-308 Beverly Rd.
Mt. Lebanon
Pittsburgh 16

Rochester Model R-1

Rochester Model R-2
Mfr., Rochester Acoustical Laboratories, Inc.
117 4th St., S. W.
Rochester, Minn.

Silver Micronic (Magnetic and Crystal)
Models 202M and 202C
Mfr., Micronic Company
727 Atlantic Ave.
Boston 11
(See Micronic)

Silvertone Model 103BM
Mfr., National Hearing Aid Laboratories
815 S. Hill St.
Los Angeles 14
Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model 103BM
Mfr. National Hearing Aid Laboratories
815 S. Hill St.
Los Angeles 14
Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model J-92
Mfr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model M-35
Mfr., Micronic Company
727 Atlantic Ave.
Boston 11
Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Silvertone Model P-15
Mfr., W. E. Johnston Mfg. Co.
708 W. 40th St.
Minneapolis 8
Distr., Sears, Roebuck & Company
925 S. Homan Ave.
Chicago 7

Solo-Pak Model 99
Mfr., Solo-Pak Electronics Corp.
Linden St.
Reading, Mass.

Sonotone Model 700

Sonotone Model 900

Sonotone Models 910 and 920

Sonotone Model 925

Sonotone Model 940
Mfr., Sonotone Corporation
Elmsford, N. Y.

Super-Fonic Hearing Aid
Mfr., American Sound Products, Inc.
1303 S. Michigan Ave.
Chicago 5

Televox Model E
Mfr., Televox Mfg. Company
1307 Sansom St.
Philadelphia 7

Telex Model 22

Telex Model 97

Telex Model 99

Telex Model 200

Telex Model 300-B

Telex Model 400

Telex Model 1700

Mfr., Telex, Inc.
Telex Park
Minneapolis 1

Tonamic Model 50

Mfr., Tonamic, Inc.
12 Russell St.
Everett 49, Mass.

Tonemaster Model Royal

Mfr., Tonemaster, Inc.
400 S. Washington St.
Peoria 2, Ill.

Trimm Vacuum Tube Model 300

Mfr., Trimm, Inc.
400 Lake St.
(P. O. Box 489)
Libertyville, Ill.

Unex Model A

Unex Midget Model 95

Unex Midget Model 110

Mfr., Nichols & Clark
Hathorne, Mass.

Vacolite Model J

Mfr., Vacolite Company
3003 N. Henderson St.
Dallas 6, Texas

Western Electric Models 65 and 66

Mfr., Audivox, Inc.—Successor to Western Electric Hearing Aid Division
259 W. 14th St.
New York 11

Zenith Model 75

Zenith Miniature 75

Zenith Model Royal

Mfr., Zenith Radio Corporation
5801 W. Dickens Ave.
Chicago 39

(All the accepted hearing devices have vacuum tubes.)

Accepted hearing aids more than five years old have been omitted from this list for brevity.

TABLE HEARING AIDS

Aurex (Semi-Portable)

Mfr., Aurex Corporation
1117 N. Franklin St.
Chicago 10

Precision Table Hearing Aid

Mfr., Precision Hearing Aids
5157 W. Grand Ave.
Chicago 39

Sonotone Professional Table Set Model 50

Mfr., Sonotone Corporation
Elmsford, N. Y.

News and Comment

AMERICAN OTOLOGICAL SOCIETY, INC., AWARD OF MERIT

The American Otological Society, Inc., announces that the Award of Merit made by the Society this year was given to Barry G. Anson, Ph.D., Professor of Anatomy, Northwestern University Medical School, and Theodore Bast, Ph.D., Professor of Anatomy, University of Wisconsin Medical School, for their joint research contributing to the knowledge of "The Embryology in Anatomy of the Temporal Bone and the Ear." The Award of Merit Medal is accompanied by an honorarium and is granted by the American Otological Society, Inc., for the purpose of recognizing outstanding service in research in otology and in the interest of encouraging research in the problems of impaired hearing.

DR. LEMPERT RECEIVES HONORARY DEGREE

One of the most distinguished honors in medicine was bestowed on Dr. Julius Lempert of New York on May 30, 1951, by the Karolinska Mediko-Kirurgiska Institut (Caroline Medical-Surgical Institute). The degree of honorary Doctor of Medicine is a national honor. This is the first honorary degree of Doctor of Medicine bestowed by this venerable Institute on an otologist, and that an American, Dr. Julius Lempert, was the first to have received it is an indication of the greatness of his contributions.

The ceremonies attending the award were held in the beautiful Stockholm Town Hall, one of Europe's most distinctive buildings architecturally, which afforded a fine setting for the ceremony, which is performed in strict dignity and formality. Prof. Arvid Wallgren officiated at the presentation ceremony in the awarding of the degrees. In his remarks he expressed the appreciation and admiration of the Caroline Institute for the contributions to otology by Dr. Julius Lempert, particularly in the surgery of otosclerosis. By his contributions he made it possible to restore satisfactory hearing to many thousands of hard of hearing persons. Prof. Wallgren emphasized that this distinction also expressed the gratitude of the Institute for Dr. Lempert's help in the advancement of otological surgery in that department of the Institute.

Dr. Lempert's American colleagues are justly proud of the honor that he has received.

STANDARD NOMENCLATURE OF DISEASES AND OPERATIONS

Fourth Edition

The American Medical Association announces the publication of the Fourth Edition of "Standard Nomenclature of Diseases and Operations." Changes in the new edition have been as much as possible kept to a minimum. Nevertheless, advancing knowledge has made necessary a complete revision of the section on the psychobiologic unit, diseases of the hemic and lymphatic systems, and tumor etiology. A completely new feature of this edition is the inclusion of code numbers of the International Statistical Classification of Diseases, Injuries, and Causes of Death, parenthetically in the body of the book, and a cross reference of International and Standard code numbers as an appendix. The new edition is being published for the Association by The Blakiston Company (Philadelphia) and will be available Jan. 2, 1952.

Directory of Otolaryngological Societies *

INTERNATIONAL

PAN AMERICAN ASSOCIATION OF OTO-RHINO-LARYNGOLOGY AND BRONCHO-ESOPHAGOLOGY

Meeting: Third Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology
Place: Habana, Cuba. Time: January, 1952.
President: Dr. José Gros. Information may be secured from Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.

SECOND LATIN AMERICAN CONGRESS OF OTORHINOLARYNGOLOGY AND BRONCHOESOPHAGOLOGY

President: Prof. A. de Paula Santos.
Secretaries: Dr. José de Rezende Barbosa, Dr. Plinio de Mattos Barretto, Hospital das Clinicas, São Paulo, Brazil.
Place: São Paulo, Brazil.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

Chairman: Dr. Carl H. McCaskey, 20 N. Meridian St., Indianapolis.
Secretary: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis 3.
Place: Chicago. Time: June 11-13, 1952.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Derrick Vail, 700 N. Michigan Avenue, Chicago 11.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 14-20, 1951.

AMERICAN BOARD OF OTOLARYNGOLOGY

Secretary: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Place: Palmer House, Chicago. Time: Oct. 9-12, 1951.
Place: Royal York Hotel, Toronto, Canada. Time: May 13-16, 1952.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION

President: Dr. Herman J. Moersch, Mayo Clinic, Rochester, Minn.
Secretary: Dr. Edwin N. Broyles, 1100 N. Charles St., Baltimore 1.

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. H. Marshall Taylor, 111 W. Adams St., Jacksonville, Fla.
Secretary: Dr. Louis H. Clerf, 128 So. 10th St., Philadelphia 2.
Place: Royal York Hotel, Toronto, Canada. Time: May 23-24, 1952.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Royal York Hotel, Toronto, Canada. Time: May 20-22, 1952.

SECTIONS:

Eastern.—Chairman: Dr. Francis W. Davison, Geisinger Memorial Hospital, Danville, Pa.
Place: Waldorf-Astoria, New York. Time: Jan. 11, 1952.
Southern.—Chairman: Dr. Lester A. Brown, 490 Peachtree St., Atlanta.
Place: Academy of Medicine, Atlanta. Time: Jan. 14, 1952.
Middle.—Chairman: Dr. Ralph J. McQuiston, 20 N. Meridian St., Indianapolis.
Place: Indianapolis Athletic Club, Indianapolis. Time: Jan. 28, 1952.
Western.—Chairman: Dr. Howard P. House, 1136 W. 6th St., Los Angeles.
Place: County Medical Building, Los Angeles. Time: Jan. 19-20, 1952.

AMERICAN OTOLOGICAL SOCIETY

President: Dr. Gordon D. Hoople, 1100 E. Genesee St., Syracuse, N. Y.
Secretary: Dr. John R. Lindsay, 950 E. 59th St., Chicago.
Place: Royal York Hotel, Toronto, Canada. Time: May 18-19, 1952.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

President: Dr. Norman N. Smith, 291 Whitney Ave., New Haven 11, Conn.
Secretary: Dr. Joseph G. Gilbert, 111 E. 61st St., New York 21.

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

President: Dr. William H. Evans, 24 Wick Ave., Youngstown 3, Ohio.
Secretary-Treasurer: Dr. Joseph Hampsey, 806 May Bldg., Pittsburgh 22.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

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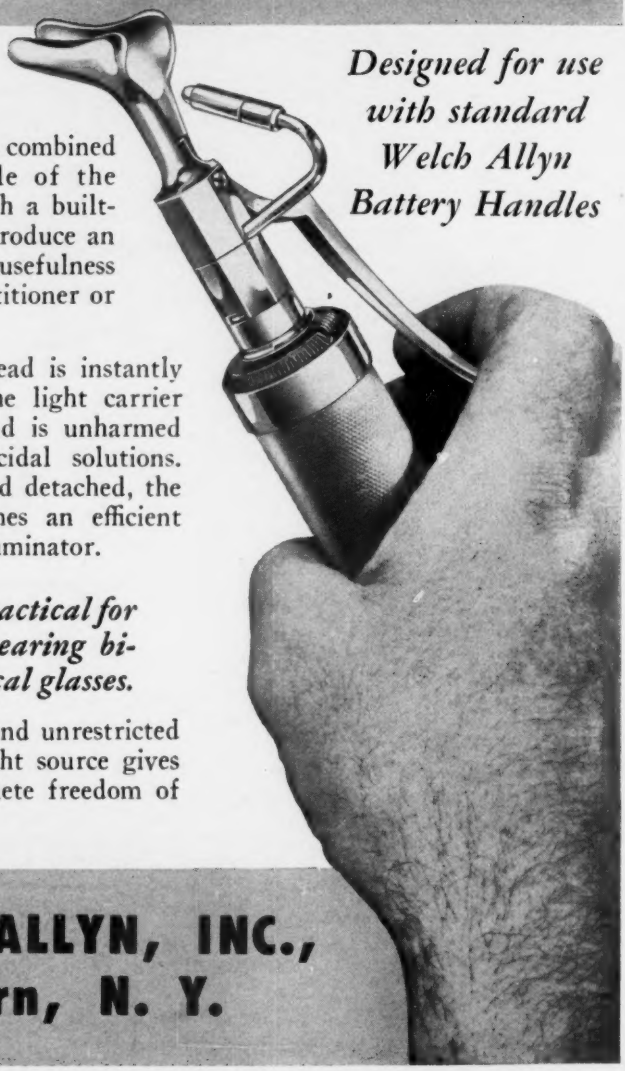

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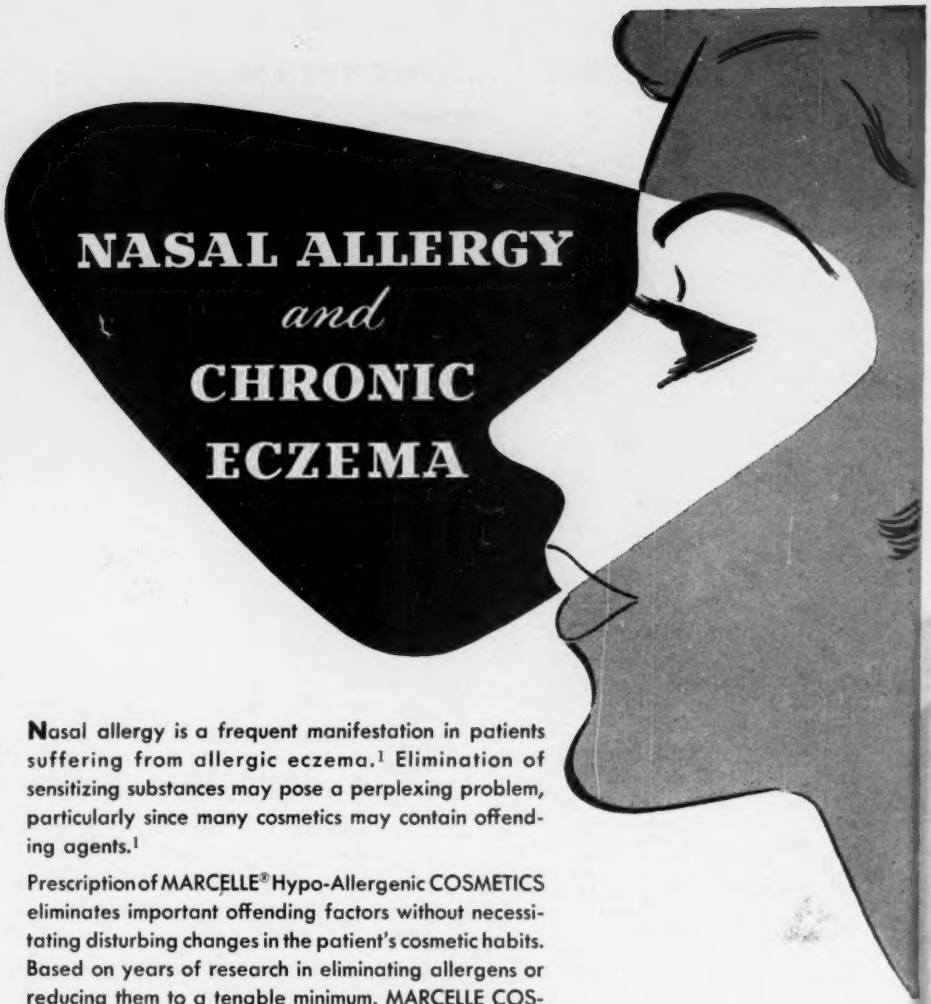

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1. Waldbott, G. L.: Management of Allergic Eczema. Am. Pract. 4:59-63 (Oct.), 1949.

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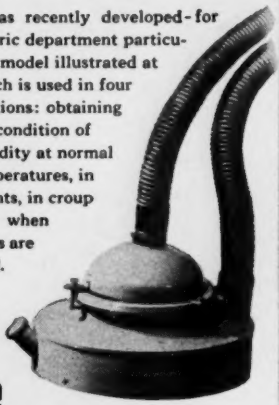

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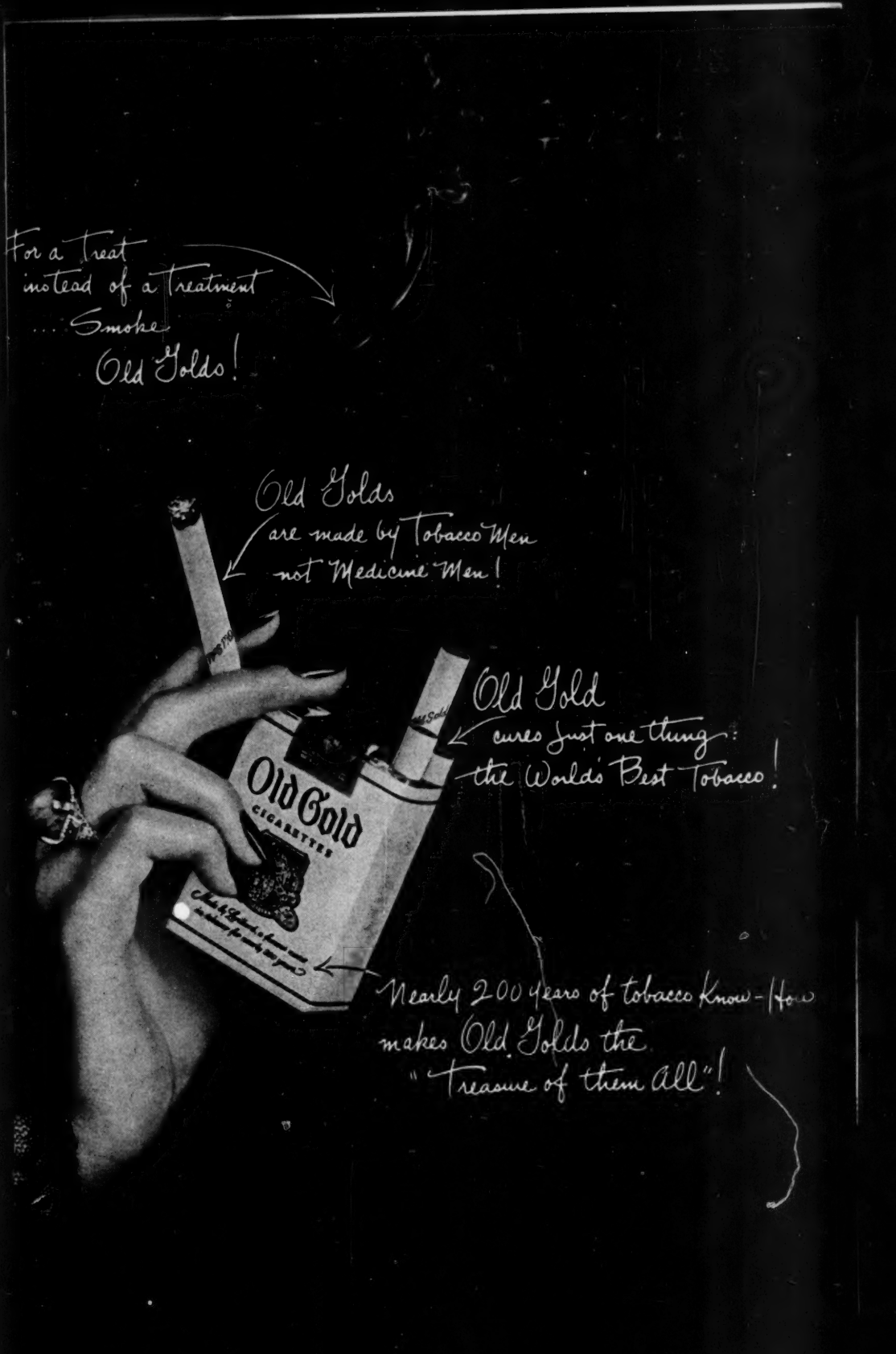
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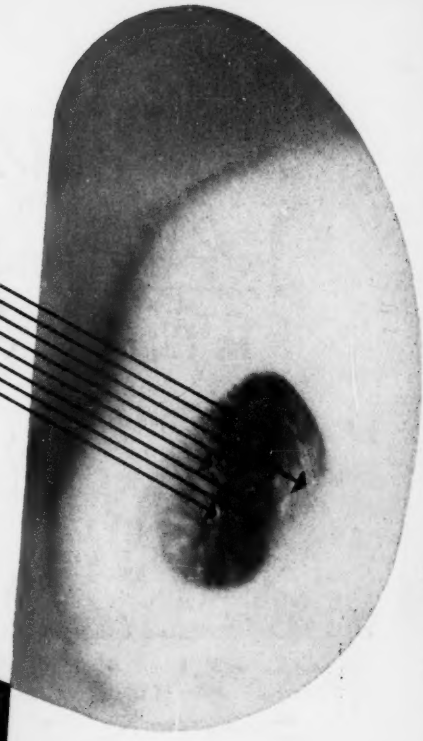

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